SUMMARY REPORT

OF THE

MINES BRANCH

OF THE

DEPARTMENT OF MINES

FOR THE CALENDAR YEAR ENDING DECEMBER 31

1910

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1911

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To His Excellency the Right Honourable Sir Albert Henry George, Earl Grey, Viscount Howick, Baron Grey of Howick, a Baronet, G.C.M.G., &c., &c., &c., Governor General of Canada.

MAY IT PLEASE YOUR EXCELLENCY:

The undersigned has the honour to lay before Your Excellency, in compliance with 6-7 Edward VII, Chapter 29, section 18, the Summary Report of the work of the Mines Branch of the Department of Mines during the calendar year ending December 31, 1910.

(Signed) W. TEMPLEMAN,
Minister of Mines.

Hon. Wm. Templeman,
Minister of Mines,
Ottawa.

Sir:—I have the honour to submit herewith, the Director's Summary Report of the work of the Mines Branch of the Department of Mines during the calendar year ending December 31, 1910.

I am, sir, your obedient servant,

(Signed) A. P. LOW,
Deputy Minister.

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SUMMARY REPORT

OF THE

MINES BRANCH OF THE DEPARTMENT OF MINES

FOR THE CALENDAR YEAR ENDING DECEMBER 31, 1910

A. P. Low, Esq., LL.D.,
Deputy Minister,
Department of Mines.

SIR:—

I have the honour to submit, herewith, the Summary Report of the Mines Branch of the Department of Mines for the calendar year ending December 31, 1910.

CHANGES IN STAFF.

Theophile C. Denis, B.Sc., Mining Engineer, resigned March 31, 1910, to accept the position of Superintendent of Mines, Department of Colonization, Mines, and Fisheries, Province of Quebec.

During the year the following appointments have been made to fill positions on the staff of the Mines Branch:—

Geo. C. Mackenzie, B.Sc., M.E., appointed April 1, 1910, as ore dressing expert.

J. G. S. Hudson, M.E.—who had been employed by the Mines Branch since August, 1908, to prepare a report on "Coal Mining in Nova Scotia"—was appointed as mining engineer on April 1, 1910.

H. S. de Schmid, M.E., appointed in May, 1910, as mining engineer.

Edgar Stansfield, M.Sc., appointed July 1, 1910, as chemist.

L. H. S. Cole, B.Sc., appointed August 22, 1910, as assistant mining engineer.

C. T. Cartwright, M.E., appointed May 19, 1910, as assistant mining engineer.

A. Ellement, appointed as packer, Aug. 3, 1910.

INTRODUCTORY.

A glance at the various lines of economic work indicated in the following pages, and at the description of the new enterprises undertaken, will show that the work of the Mines Branch is becoming more *practical* every year. This is evidenced by the

rapid exhaustion of the monographs on the chief mineral resources of the country: such as asbestos, mica, etc.; and the increasing demand for the bulletins on electric smelting of iron ores and on the manufacture of peat fuel.

Among the new lines of mineralogical investigation initiated during the year, was that of a study of the building and ornamental stones of Canada. This work is of considerable importance in view of the great demand for building materials needed in the construction of the immense number of homes, innumerable civic institutions, public works, and industrial establishments necessitated by our progressive civilization. But while the work done towards utilizing the metallic and non-metallic mineral resources of the country is of ever increasing importance, the immediate necessity of protecting the lives of the army of men engaged in the mining industries of the Dominion is of paramount importance. The annual loss of life in Canada, due to explosions in mines and factories, has been deplorable—as the comparative statistics on page 157 clearly show. Most of the accidents were due to lack of protective laws and regulations. Perceiving this, the Mines Branch set to work early in the year to remedy this state of affairs. Aided by the best expert assistance available, information and data regarding the conditions peculiar to Canada were gathered, and a comprehensive Explosives Bill prepared and duly submitted to Parliament by the Honourable the Minister of Mines on December 13, 1910. If anything could expedite the passing of such a Bill, it assuredly should be the reading of the reports on pages 137, 140 and 144, giving detailed accounts of the three terrible disasters which occurred during 1910—while the Explosives Bill was being prepared.

In connexion with this question of explosives, one of the most urgent requirements is the establishment of an explosives testing station at Ottawa—under direct governmental control. Preliminary steps have already been taken towards the planning of such a station. A suitable site is available, in close proximity to the government Fuel Testing Station and concentration laboratory on Dolly Varden and Division Streets, Ottawa.

In keeping with the government policy of taking the initial steps towards developing the material resources of the country—as in the case of electric smelting of refractory iron ores, and the manufacture of cheap peat fuel; so, this year, the Mines Branch has established a permanent magnetic separation and concentration plant at Ottawa. When it is remembered that over 80 per cent of the iron ores used in the blast furnaces of Canada are imported, any movement which promises to economically utilize our own resources, encourage the investment of capital, and employ Canadian labour, is manifestly a step in the right direction. This is precisely what the installation of a modern ore dressing and concentration laboratory at Ottawa means.

PROGRESS IN ELECTRO-METALLURGY.

During 1910 very little progress was made in Canada along the lines of electric smelting.

Three years ago, inactivity on the part of practical men was attributed to the lack of evidence as to the commercial advantages of the electro-thermic process. In August, 1909, however, the proof of the practicability of the electric shaft furnace

for the smelting of refractory iron ores on a commercial scale was set forth in a Mines Branch report on the subject[1]; and all subsequent data have been confirmatory of the satisfactory results then given out.

The following extracts from foreign technical journals, and communications from reliable official sources, will show that the commercial advantages of the electric furnace for the smelting of iron ores are being fully recognized and utilized by other countries.

EXTRACT FROM *Page's Weekly*, LONDON, ENGLAND, SEPTEMBER, 1910.

Electric Smelting in Norway.

"Foremost among the new industrial projects in the Bergen district must be placed that of the electric smelting of iron and steel. As far as I can ascertain, writes Consul F. Drummond-Hay, two processes have been tried in western Norway. One of these is described as the method employed by the Noble Electric Steel Company at Heroult, in California, and is stated to have been tried at some smelting works at Trondhjem. The other method is the Grönvall process; and a company is being formed for the erection of electric iron and steel smelting works near the growing industrial centre of Odda, in Hardanger; the necessary electric power to be supplied by the Tysoe Falls Company, in that neighbourhood. It is stated that this undertaking will probably prove of great importance for the utilization of Norwegian low grade ores."

Teknisk Tidskrift, September 10, 1910.

The Electric Smelting of Iron Ore in Sweden.

The first experiments in electric smelting of iron ore in our country were made in 1906, and have since then continued with various types of furnaces and gradually added improvements. We have now advanced so far, that it may be stated that the results obtained indicate that, *the economical solution of the production of pig iron in the electric furnace has been made within known limits.*

The experimental furnace at Domnarfvet is now torn down, and work has commenced in the erection of new electric furnaces, thus pointing to the introduction of a permanent production of pig iron by the electro-thermic process. Power will be furnished by the new power station at Bullerforsen, which at high water delivers 24,000 H.P. Not less than ten such furnaces will be gradually erected by the Stora Kopparbergs Bergslags Aktiebolag at Domnarfvet, and for their operation a new power plant is being planned at Forshuford above the Kvarnsveden paper mill. The furnace now under construction is expected to be ready for operation in February of next year, and is designed for a production of 12,000 tons of pig iron per year from 4,000 H.P. The cost of the furnace is estimated at 40,000 kronor.

The experimental furnace now being built at Trollhättan will require 2,500 H.P. with a yearly production of 7,000 tons of iron.

The Hoganas works are also interested in the electric smelting method, and are at the present time constructing one furnace with yearly capacity of 10,000 tons of pig iron, and intend to gradually increase their plant to ten furnaces of 10,000 to 12,000 tons each.

These better known projects for the utilization by the electric process of the country's iron ore resources mean a yearly pig iron production of 250,000 tons, which is a significant revolution in the pig iron production, a development of our water powers, and increased mining of iron ore.

August 6, 1910.

Announcement made by *The Mining and Scientific Press* that 5 additional electric furnaces for the production of pig iron are being installed at Heroult-on-the-Pitt, Shasta county, California.

The plans drawn by Engineer Carl von Waldeck for Mr. Boholm of Trondhjem, Norway, for the erection of an electric smelting plant producing pig iron, contemplate the use of the Lyon's furnace, type of which is in operation at Heroult-on-the-Pitt, Shasta county, California.

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[1] See report (No. 32) on the Investigation of an Electric Shaft Furnace, Domnarfvet, Sweden, (Second Edition), by Dr. Eugene Haanel, 1909.

Extracts from Swedish Journals.

Plate I.

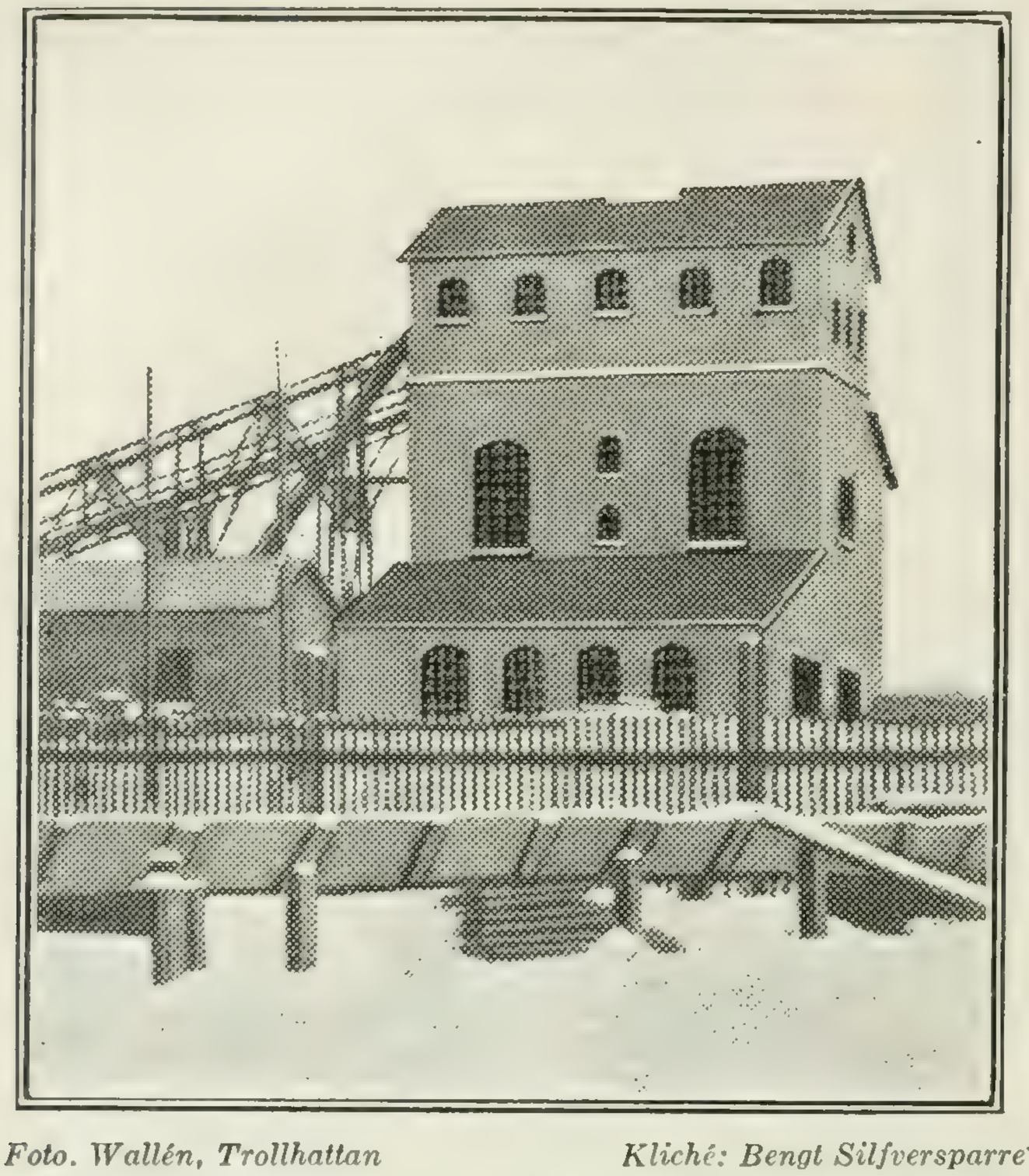

Foto. Wallén, Trollhattan *Kliché: Bengt Silfversparre*

Jarnkontorets Experimental Electric Furnace, Trollhättan.

(*a*)

The electric furnace at Trollhättan has been in continuous operation since Nov. 15 (1910) and the results of the experiments indicate the realization of the highest expectations. Any exact figure as to the production of pig iron, per H.P. year, is not obtainable; but, it has been stated authoritatively, that it is more than 3 tons. (From *Weekly Magazine*, Gothenburg—Hvar 8 Dag.)

(*b*)

With all preliminary work concluded at the Alfharleby waterfall, it has been decided to commence immediately the work of developing power, with an initial installation of machinery for 18,000 H. P. (to be increased to 42,000).

(*c*)

Since the commercial success of the electric smelting method of iron ore has been established by the most favourable results obtained by Jarnkontoret's electric smelting furnace at Trollhättan, a large part of this power is to be used for this purpose. (*Svenska Dagbladet*)

Communication From Swedish Consul.

Sweden.

The Royal Swedish Consulate in Montreal communicates the following information regarding the progress of electric smelting in Sweden and Norway, which data were obtained from the Royal Department of Foreign Affairs, Sweden:—

(1) The furnace at Trollhättan is constructed for 2,500 H.P. with a production of about 7,500 tons.

(2) At Domnarfvet one furnace of 4,000 H.P., with 12,000 tons capacity, is under construction and is expected to be in operation this summer.

(3) Another large iron works, the name of which at the present time we are not at liberty to give, will erect two furnaces of 2,500 H.P. each, with a combined output of 15,000 tons. These furnaces should be in operation this coming autumn.

Regarding the results obtained at Jarnkontorets furnace at Trollhättan, we are not at the present time in possession of an official report, but may communicate that the furnace has been running continuously since November 15, and up to the 18th of February produced 1,271 tons pig iron, with a power consumption of 2,150 kw. hours (corresponding to 3,000 kg. (3·3 tons) pig iron per H.P. year). Coal consumption is 24·40 hectolitres (of 70% C), and the electrode consumption of 11 kg. gross weight and 6 kg. net weight per ton of pig iron. These figures are averages for the whole period of the run.

It may also be stated that the durability of the furnace has proved to be very satisfactory. (The above figure, 2,150 kw., has been obtained according to a curve of correction, recently obtained when controlling the measuring instruments at Trollhättan)

These furnaces are all constructed according to the patents of A. B. Electrometall.

(4) The Hagfors furnaces will have a capacity of 18,000 tons per annum, each furnace using 3,000 H.P.

Norway.

A. S. Hardanger Elektriske Jern-og Staalverk was incorporated in 1910 with a capital of 1,200,000 kronor. They are now building one electric furnace of 3,500 H.P., producing about 9,000 tons of iron per year. This furnace will be ready to run by the end of the coming summer. Later, an electric steel furnace and rolling mill will be erected.

A. S. Fosse kompagni was incorporated this year with a capacity of stock of 2,200,000 kronor. The Company has floated a loan of two million kronor, of which the Royal Bank of Norway has taken up half. The iron works will consist of electric iron and steel furnaces, with a production of 14,250 tons of billets per year. This plant is expected to be ready by the beginning of 1913.

At last we beg to add that the Fosse Company, which is an old iron works and has been idle for a long time, has closed contract for erection of an electric pig iron furnace of 3,000 H.P.

Steel Making in the Electric Furnace.

Hitherto, public references to the manufacture of steel by means of the electric furnace have consisted mainly of statements of results, and graphic descriptions of the apparatus and mechanical appliances used. Very little has been given out explanatory of the chemical reactions involved in the electro-thermic process itself. A few notes, therefore, on the more technical and physical aspect of the subject may, at this stage, be deemed opportune. In October, 1910, Professor Joseph W. Richards—in an article in *The Metallurgical and Chemical Engineering Journal*, entitled, "The Passing of Crucible Steel"—reviews the work being done in Germany in the refining of iron into steel; and describes, particularly, the processes used in the works of the Stahlwerke Rich, Lindenber, Aktien Gesellschaft, at Remscheid-Hasten. Professor Richards says:—

As to the reactions in the process, phosphorus and other oxidizable elements are completely eliminated by the first slag; copper and arsenic are not, and should, therefore, not be in the molten metal charged in any harmful quantity. Sulphur is eliminated by the action of calcium carbide formed in the second slag:—

$$CaC_2 + FeS = CaS + FeC_2.$$

In this second stage, silicon, manganese, chromium, nickel, vanadium, molybdenum, boron, or tungsten are added to the steel with quantitative accuracy, scarcely a trace of any of these additions passing into the slag, and the steel having the exact calculated composition.

Comparing the electric process as here developed with the crucible process thus displaced, the management, after five years' experience, affirms with the greatest positiveness that the electric steel is more nearly of the desired composition; more uniform in composition; can be made from far cheaper raw materials; costs far less for the smelting operation; far less for labour; the labour required is much easier and safer; the output per given sized plant is greater; the steel is more free from blow-holes; develops less edge-cracks or surface faults; and for a given ductility will carry more carbon and, therefore, show higher strength.

Commercial Aspect of Electric Steel Making.

The following statement of the intrinsic properties of the steel demanded for the purposes of modern constructional engineering, shows that steel manufactured in the electric furnace is ideally adapted for all commercial purposes. In a paper read before the Chicago section of the American Electrochemical Society[1] Mr. James Lyman says:—

> The demand for strictly high-grade steel, absolutely homogeneous, with fine grain, is to-day coming from the railways for steel rails and structural bridge steel, from the government for armament, from the automobile industry, from every manufacturer of tools and machinery, engines, steam turbines, electrical manufacturers, and, indeed, every manufacturer using iron or steel. The treatment of Bessemer and open-hearth steel in the electric furnace at an increased cost entirely within the limits of the purchaser will make this steel comparable in its fineness with crucible steel, and have the physical characteristics best adapted to the particular application desired. Since the railways have investigated the causes of rail breakages, it has been proved that many of them were due to the presence of foreign injurious bodies, such as slag, manganese sulphides, etc. The possible presence of these impurities, as well as the products of oxidation and nitrogen, is inherent in the Bessemer and open-hearth furnace product, but can be almost entirely eliminated by a treatment of an hour or two in the electric furnace.
>
> Rails from electric furnace steel are now being tried out on curves, railway crossings; and points where the service is most severe by a number of the large railway systems. These rails combine unusual tensile strength, toughness, and hardness. Their life alone, aside from their increased reliability, will probably justify the increased cost.
>
> To bring the enormous output of steel rails, structural, merchant, and plate steel up to the high grade of crucible steel will mean a new era for the steel business and rapid advances in all lines of manufacture employing iron and steel.
>
> The manufacture of modern and light-weight steel castings has always been a difficult and unsatisfactory problem. There is a large wastage, particularly in castings of odd shapes. This is principally due to impurities and sluggishness of the flow of metal in castings. With less than one-third the electric power necessary for purification, the liquid metal can be held indefinitely in an electric furnace without any loss in its composition or danger of burning, and a highly liquid metal can be cast uniformly free from impurities and gases. Such steel castings can in a large measure replace the steel forgings at present used, at a much reduced price. While the large steel companies will, no doubt, introduce electric furnaces as a refining means for their principal output, the electric furnace can probably be used to advantage by manufacturers of all kinds of iron and steel products in making special high-grade steels from their waste scrap iron and steel, including borings and turnings, as it accumulates in process of manufacture. These furnaces will either be entirely electric or the metal may be brought to the melting point by gas or coke fuel, and then treated by electric heat.

The advantages of the electric furnace for commercial work have been admirably summarized as follows[2]:—

> (1) That the electric furnace itself has passed from the field of experiment to that of engineering, but that the fields of manufacture using the electric furnace products are still experimental.

---

[1] The Electric Furnace for the Manufacture of Iron and Steel, by James Lyman.

[2] "The Reliability of Electric Furnaces for Commercial Work," by Fred. T. Snyder, a paper read before the American Electro-chemical Society, 1910.

(2) That the electric furnace is technically reliable and will operate continuously with the men and supplies that are available in this country. That the details are simple and rugged, and that the inherent regulating powers can be made such as to bring it well within the ability of usual plant labour.

(3) That the electric furnace is commercially reliable. That when installed with the same business care and adaptation to conditions that should be used with other furnaces, it will earn a profit on the investment, and a profit that is larger than the normal manufacturing profit in proportion as the field is newer and more open.

Comment.

The foregoing notes show (1) that the claims made by the Mines Branch since 1905-6, as to the suitability of the electric furnace for meeting the metallurgical conditions peculiar to Canada, have been fully substantiated, and (2) that European countries like Sweden and Norway, as well as the United States, are eagerly availing themselves of the pioneer work done by Canada in the development of the electro-thermic process for the smelting of refractory iron ores. The progressive spirit evinced by the ironmasters and captains of industry in the above-mentioned countries is in marked contrast to the condition of *inertia* prevailing in Canada. Since the winter of 1905-6 the Dominion Government have spent a considerable amount of money on experiments, and utilized the services of their technical experts in an effort to solve—theoretically and practically—the problem of economically smelting the refractory iron ores of the country, and have succeeded even beyond expectation. It is hoped, therefore, that the evidence of activity in other countries, given in the above extracts, may be an incentive to Canadian manufacturers to utilize the electric furnace—wherever iron ore deposits, suitable fluxes, and metallurgical fuel, are in strategic proximity to cheap water power—and thus bring about the establishment of an iron and steel industry, commensurate with the growing commercial importance of the country.

PEAT FUEL INDUSTRY

The forward movement begun by the Mines Branch in June, 1906, to solve the problem of providing a cheap domestic fuel for the middle provinces: Quebec, Ontario, and Manitoba—where there is no coal, but very extensive peat bogs—attracted, on account of its commercial importance, wide attention. Indeed so much so, that the American Peat Society, recognizing the essentially practical work being done by the Canadian Government, held its annual meeting at Ottawa on July 25, 26, and 27, 1910. The government peat plant at Alfred, Ont., was visited by the members of this national organization, as also was the Fuel Testing Station at Ottawa, and the impressions made were crystallized into the following resolution, adopted unanimously at the last session held July 27, 1910:—

> Resolved: that the American Peat Society hereby expresses its thanks to the Hon. Wm. Templeman, Minister of Mines, for his cordial welcoming telegram, and for the opportunity of visiting the most interesting and satisfactory demonstration peat-fuel plant at Alfred, and the peat gas producer and power plant in Ottawa.
>
> That congratulations are extended to the Minister and to the Director and experts in charge of these plants for the success that has crowned their efforts, and the very important demonstration which they have made of the practicability of making peat-fuel in quantities, and of using it for the production of power.

This authoritative testimony to the success of the attempt made by the Mines Branch to solve the problem of economically manufacturing peat fuel needs no extended comment; except to state that the aforesaid convention resulted in the

establishment of a Canadian Peat Society: an organization which has already done effective practical work. During the autumn, some 500 tons of peat fuel, manufactured at the Alfred plant, were sold at $3.25 to $3.50 per ton to private individuals in Ottawa, for domestic use. The reports coming in from the consumers—showing that the peat has given great satisfaction as a fuel for open fire grates, cooking stoves, and even in furnaces for heating the house; and the numerous inquiries from business men and capitalists are so encouraging, that, with the advent of spring it is confidently anticipated there will be a marked revival of interest in the peat industry throughout the provinces where there is no coal.

Since 1907, ten peat bogs have been investigated, delimited, and plans made thereof. In 1910, only one was investigated, viz., the Holland peat bog, situated in Simcoe county, Province of Ontario. This is the largest peat bog so far examined and delimited by the Mines Branch. It covers over 16,000 acres, and should produce over 9,000,000 tons of peat fuel. The report of Mr. Anrep shows that the surface of this immense bed of peat is free from trees, hence can be worked economically by labour-saving machinery; while the quality as regards ash, and calorific value is satisfactory. A bulletin and map of the bog will be published at an early date.

GOVERNMENT PEAT PLANT AT ALFRED.

The report of Mr. A. Anrep, Jr., on page 115 shows that during a period of 50 days, 1,600 tons of air-dried peat fuel were manufactured—an average of 33 tons per day—the cost being as follows:—

Cost of 1 ton of peat on field	$1.59
" " 1 " " " turned, at 6c. per ton	1.65
" " 1 " " " open piled, at 10c. per ton	1.75
" " 1 " " " stored in shed, at 25c. per ton	2.00

Analyses of Peat Fuel.

The following analyses were made in the laboratory of the Central Experimental Farm, Ottawa:—

Copy.

DOMINION EXPERIMENTAL FARMS,
WM. SAUNDERS, C.M.G., DIRECTOR.
Central Experimental Farm,
Ottawa.

DR. E. HAANEL,
Director of Mines,
Ottawa.

DEAR SIR:—

You will doubtless be interested in the following analyses recently made in the Farm laboratory of samples of peat from the Government bog at Alfred.

No. 1 is the sample supplied by yourself

No. 2 is a sample submitted by an Ottawa purchaser.

Peat as Received.

	No. 1	No. 2
Moisture	24·07	27·78
Organic matter	71·23	67·81
Mineral matter or ash	4·70	4·41
	100·00	100·00

Composition of Ash.

	No. 1	No. 2
Mineral matter insoluble in acid	19·30	17·46
Oxide of iron and alumina	23·30	20·20
Carbonate of lime	42·50	44·64
Phosphoric acid	0·797	0·604
Potash	0·65	0·48

Some few weeks previous to making the above analyses a correspondent who was burning this peat in an open grate submitted a sample of the ash so obtained, the object being to ascertain the fertilizing value of the ash for garden purposes. This ash afforded the following data:—

	Per cent.
Lime*	26·55
Phosphoric acid	0·80
Potash	0·695

*Equivalent to carbonate of lime, 47·41%.

Yours faithfully,

(Signed) **Frank T. Shutt,**
Dominion Agricultural Chemist.

In addition to the above analyses, another was made of peat ash in the Mines Branch laboratory—October 12, 1910, by Harold A. Leverin, Ch.E., as follows:—

Analysis of Ash.

(From Peat Fuel Manufactured at Alfred Peat Bog.)

SiO_2	19·30
Al_2O_3	7·78
Fe_2O_3	6·22
CaO	31·39
MgO	14·33
K_2O	1·51
P_2O_5	1·03
CO_2 (by diff.)	18·44
	100·00

PROGRESS OF PEAT INDUSTRY IN SWEDEN

De Laval Wet-Carbonizing Process.

The Swedish government have decided to grant to Dr. G. de Laval—the distinguished inventor—the sum of 19,000 kronor ($5,130) for further experimentation on his new process of wet-carbonizing peat. The Government peat engineer, Ernest Wallgren, reports that de Laval's new process may solve the problem of continuous manufacture of a fuel, independent of air-drying, which will be able to successfully compete with coal.

Peat Powder—As a Substitute for Charcoal—Used in the Electric Furnace for the Manufacture of Pig Iron from Iron Ore.

Teknisk Tidskrift. August 24, 1910.

By Prof. E. Von Odelstierna,

Stockholm, Sweden.

At Arvika, Sweden, experiments have been conducted using peat powder in the reduction of iron ore in the electric furnace.

The bottom electrode was found to cause damage to the hearth, hence was replaced with an iron electrode situated between the two carbon electrodes. Very good results were obtained.

Recently, we have succeeded in getting 2·65 tons of iron per H.P. year; 445 kilograms (981 pounds) of peat powder being required for the reduction.

The loss in weight of the iron electrode was found to be only a few kilograms per charge. The loss of the carbon electrodes was not determined, but was rather considerable.

The furnace is now being rebuilt with a view to utilizing the furnace gases for preheating the charge, and roasting the ore.

Svenska Dagbladet, December 2, 1910.

JONKOPING.

Following Captain Wallgren's very favourable address on "The Investigation of the Ekelund Peat Powder Process" before the Swedish Peat Society, Lieutenant Ekelund was interviewed, and stated that by using his process even lower grades of peat can be worked, by which a production on a large scale through the country has been made possible. New furnaces are being built at Bâck, increasing the output to 20,000 tons per annum.

Three new peat powder plants are under consideration, to be erected during the coming spring.

FUEL TESTING STATION AT OTTAWA.

PEAT GAS PRODUCER AND GAS ENGINE PLANT, AND GAS TESTING LABORATORY.

A description of the gas producer and gas engine plant erected at the Government Fuel Testing Station, Ottawa, was given in detail, in the Summary Report for 1909 (p. 12), hence it is only necessary to state that, the installation of the plant was completed about April 1, 1910. The gas analytical laboratory, however, was not ready for operations until November 1910, so that no complete chemical tests could be carried out until after that date.

Notes on peat gas producer tests, and tests of the Körting gas engine operated with gas generated from peat fuel manufactured at the government plant, Alfred, are recorded, in some detail, in the preliminary report of Mr. B. F. Haanel, chief of Fuel Testing Division, page 44; while the chemical tests will be found in the summary report of Mr. Edgar Stansfield—who is in charge of the gas analytical laboratory.

ESTABLISHMENT OF GOVERNMENT ORE-DRESSING AND CONCENTRATION LABORATORY AT OTTAWA.

The fact that Canadian blast furnaces are dependent upon foreign mines for over 80 per cent of their supply of iron ores, indicates that, our resources of ore suitable for reduction by existing methods of smelting, are, as far as known, limited. At the same time, extensive deposits of low-grade ores—which the ironmaster can not use in their natural condition—are known to exist in large quantities, at accessible points, in many parts of the Dominion; and if these hitherto negligible deposits of iron ore could be utilized economically, it would encourage the growth of our iron and steel industry. Recognizing this situation, the Mines Branch has undertaken the work of demonstrating that the low-grade iron ores of Canada may be rendered acceptable for smelting, by the adoption of modern methods of ore-dressing.

With this object in view, the mining laboratory of Queen's University, Kingston, Ont., was temporarily secured for experimentation and testing during the autumn and winter of 1909-10. Tests were completed on the high sulphur iron ores of the Bristol mine, Pontiac county, Que., and the siliceous ores of the Bathurst range, N.B. Experiments were also conducted with a copper-nickel ore from the Worthington mine, Ontario, with a view to ascertaining the practicability of producing therefrom, iron-nickel concentrates free from copper; for the subsequent manufacture of ferro-nickel pig. The results of these experiments were, from the standpoint of concentration, entirely satisfactory. A detailed report of these experiments was

published in 1910.[1] Immediately after the completion of these tests at Kingston, a government owned plant was installed at the Fuel Testing Station, Ottawa; for the experimental concentration of low-grade magnetic iron ores. This plant consists of a complete working unit of the Swedish Gröndal separating system: consisting of an ore crusher, ball mill, and two magnetic separators. The machines are of standard, commercial size, the capacity of the unit being from 50 to 100 tons of crude ore per 24 hours. The motive power is derived from the gas producer plant of the Fuel Testing Station, which is operated with peat fuel from the Government bog at Alfred.

That the establishment of this ore-dressing laboratory is meeting with approval from the mining public is evidenced by the fact that some 80 odd tons of various ores from Ontario, New Brunswick, and Nova Scotia have been received for testing purposes. These samples, ranging in size from 2 to 5 tons, are now undergoing treatment.

The summary report of the ore-dressing laboratory, page 48, contains the details of the experiments with Wilbur waste ore, and it is encouraging to note that low-grade material of this character, containing 38 per cent of iron, will yield a 65 per cent concentrate, with a recovery of nearly 95 per cent of the original iron.

A full report of the operation of the ore-dressing laboratory for the year will be issued later in bulletin form. This report will contain complete data of all experimental testing, accompanied by descriptive drawings of the various machines and apparatus.

INVESTIGATION OF PROCESSES FOR THE REDUCTION OF REFRACTORY ZINC ORES.

The following petition—signed by the zinc producers of East and West Kootenay, British Columbia—asking for an investigation of modern processes for the extraction of zinc from refractory ores, and dated April 7, 1910—was addressed to the Honourable the Minister of Mines:—

Petition

HON. WILLIAM TEMPLEMAN,
Minister of Mines,
Ottawa.

SIR,—

I have the honour to submit on behalf of those engaged in zinc mining in British Columbia, certain facts in regard to the present condition of the industry.

In the report of the Commission appointed to investigate the zinc resources of British Columbia, it was estimated that the productive capacity of the mines for zinc ore might be expected to reach 30,000 tons of ore per year, crediting 15,000 tons each to the Slocan and Ainsworth districts. The actual shipments during the year 1908 were 7,000 tons. The unsatisfactory condition of the industry is largely due to adverse transportation conditions. These ores must be shipped to smelting works in Europe to meet hostile tariff duties and the long haul to Kansas, if shipments be attempted to the United States. This disability is accentuated by the unusual character of the British Columbia zinc ores, in that a large part of their value is in the silver contained in the zinc. Under the technical conditions of smelting zinc ores in the usual retort process, the ore has to be smelted twice; first to recover the zinc,

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[1] Bulletin No. 5. Magnetic Concentration Experiments with Iron Ores of the Bristol Mines, Que., Iron Ores of the Bathurst Mines, New Brunswick, a Copper Nickel Ore from Nairn, Ontario, by Geo. C. Mackenzie.

and second to recover the silver. The cost of the double treatment and the double losses in treatment prevent the smelters from paying more than one-half of the value of the silver. A complete modern retort plant was constructed and placed in operation at Frank, Alberta, at a cost of some $300,000, for the exclusive purpose of smelting these British Columbia zinc ores. Under the technical conditions as to character of ore and economic conditions as to transportation and supply, it was found impossible to continue operations, and this plant was shut down and is being dismantled. Deprived of this market for their ores, and facing the probability of entirely losing the market of the United States zinc smelters through still higher customs duties, the miners of the west have been diligently casting about for some other way to avoid having to shut down.

The history of most of the mines is the same. Starting at the surface as lead mines carrying silver, it is found that as depth is reached, the lead is replaced by zinc to a larger and larger extent, until finally the zinc ore and its silver content is one of the principal resources. These ores of British Columbia, fairly high in zinc, unusually high in silver, and with some lead have been extremely difficult to market at any price, notwithstanding the high natural value of the contained metals. As there is no distinction in the mining of these ores in the production of lead and zinc, the utilization of both is each essential in the production of the other.

Thorough and repeated examinations were made of all known and available processes which indicated any prospect of handling these zinc-silver ores. Of these the only plan which offers hope of economic success in British Columbia was the smelting of these ores with electricity. If such an ore be put into a lead-silver blast furnace, the blast burns the zinc to oxide as fast as smelted and this oxide accumulating on the ore clogs up the furnace and soon stops its operation. A certain small amount of such oxide (15%) can, with skilful smelting, be dissolved in the slag and so gotten out of the way. Zinc so put into the slag is economically lost as there is no known way of profitably recovering it. Where electricity is used for heat the zinc is not burned as reduced and may be removed and recovered as a saleable product. While this process was known to be scientifically sound, there was no actual electric zinc smelting plant in successful operation adapted to British Columbia conditions which could be copied. It was necessary to have a process by which the zinc would be saved as well as the silver and lead. In this extremity a number of the prominent mine owners and operators interested themselves in the experiments that had been carried on for some time at Vancouver in the electric smelting of zinc-silver ores. Numerous tests were made on samples of ores shipped from the different mines. So encouraging were the results obtained that a company was organized, "The Canada Zinc Company," to carry the work further on a larger scale. A site was secured at Nelson, British Columbia, lying between the track of the Canadian Pacific railway and the west arm of Kootenay lake. At this point an abundant supply of low cost electricity is available from the Bonnington falls of the Kootenay river. Low freight rates exist from all points of the mining districts of East and West Kootenay. A small but thoroughly built smelting plant with a capacity of 10 tons of ore per day was erected at a cost of about $70,000. The experiments begun at Vancouver have been carried forward at a cost of some $50,000. These experiments proved what a difficult matter it was to handle these ores in any practical way. Gradually progress was made. One mechanical and electrical difficulty after another was successfully overcome. During this time the object was to produce from these ores three saleable products: (1), lead-silver bullion; (2), zinc in spelter form, practically free from lead and silver, and (3), a matter containing the proper contents of the ore. Operating with this object, the experiments with the plant were continued to the first of January in this year. At that time the difficulties incident to the experimental operation of the plant, had exhausted the funds of the Company. Up to the time of closing down, it has been demonstrated that the silver and lead could be effectively separated from the zinc. Some spelter was made, but further experimental work will be necessary and changes will be required in the apparatus to secure commercial results. The financial conditions of the Company have made it impossible to carry out these changes and continue the experiment. The changes necessary include rearranging the electrical equipment of the plant to operate at a pressure of 50 volts in place of 100 volts, including provision for graphite electrodes in place of amorphous carbon; making certain alterations and improvements to the present 800 H. P. furnace which suggested themselves during its operation, and installing chambers for burning, settling, and collecting the zinc in the form of zinc-oxide. These proposed changes and the operation of the plant to demonstrate their commercial practicability will cost approximately from $20,000 to $25,000.

In view of the pending changes in the United States tariff, which, as soon as put into force, will absolutely prohibit the exportation of zinc ore from Canada to the United States, it is necessary if the industry is to continue that Canada should be provided with domestic zinc smelting facilities for treating its own ore. In the absence of a successful process for this purpose it has been impossible to enlist capital for this undertaking.

I, therefore, respectfully urge your Government to make provision for completing the experimental work begun by the Canada Zinc Company. On making an appropriation for this purpose, the Company are willing to place their entire plant at the disposal of the officers

of your Department and to render them every assistance in their power to complete the experiments and demonstrate the commercial practicability of smelting the zinc-ores with electricity.

With this advantage, the zinc industry can be developed into one of great importance to Canada and your Department; by granting the assistance at the present time you will do for this industry what you have so successfully done for the iron and steel industries by the experiments in electric smelting carried to so successful a conclusion by your Department.

With unlimited water power in all parts of the Dominion and with its inexhaustible and diversified mineral resources, no country has more to gain from electric smelting than Canada.

I am fully convinced that a small amount of money expended by your Department as indicated above, will prove the greatest possible boon to the zinc industry.

I remain,

Yours respectfully,

(Signed) **Louis Pratt,**
Representing the Zinc Producers of East and West Kootenay.

Recommendations of Director.

In response to the request of the Honourable the Minister of Mines, the following Memorandum was prepared by the Director of Mines; dealing with the foregoing petition, and making certain recommendations:—

Copy

Ottawa, January 3, 1910.

Memorandum:
Honourable William Templeman, M.P.,
Minister of Mines.

I have the honour to submit the following statement regarding the petition to divert $50,000 of the unearned portion of the lead bounty fund to be used to complete the experiments in smelting zinc ores by the electro-thermic process, which have been carried on by the Canada Zinc Company at Nelson, B.C.

Recognizing the pressing need of the zinc miners of British Columbia, as set forth in their petition, of finding some method which will enable them to market the output of their mines in the form of some manufactured product, and the propriety of the Government to come to their assistance, I am of the opinion that, *instead of making an appropriation for the continuance of the smelting experiments made at Nelson, B.C., so far without success*, information should *first* be obtained of the different processes which have been invented in Europe, and one of which has been in actual operation for some years.

There are at present four processes which promise commercial results:—

1st: The De Laval process, *in operation* at Trollhätten, Sweden; the final product of which is spelter.

2nd: The improved process of De Laval, plant for the demonstration of which is under way of erection by Mr. Ferguson, in London, England. Final product spelter. This process claims to save all the valuable contents of the ore and the sulphur in a solid state.

3rd: The Coté-Pierron process, recently invented in France. Final product spelter, or zinc oxide.

These three processes are electric smelting processes.

4th: The bisulphite process—final product zinc oxide. Plant for demonstration on a commercial scale, which is being erected in Wales, approaches completion. This is a chemical process. The mineral is brought into solution and precipitated as bisulphite, which is then converted into zinc oxide.

In view of these facts, I would recommend that the petition of the zinc miners of British Columbia to divert $50,000 of the unearned lead bounty fund for the purpose of aiding the zinc miners of British Columbia in an endeavour to bring the treatment of the zinc ores in Canada to a successful issue be granted, and that that amount be placed at the disposal of the Mines Branch of the Department of Mines, to be employed:—

1st: for the investigation on a commercial scale of the processes above enumerated, or of any other process, and that detailed reports of such investigations be made to the Minister of Mines from time to time.

2nd: for the setting up and operating of an experimental plant at Nelson, B.C., to test that one of the processes reported upon, which promises commercial success in treating the zinc ores of British Columbia.

Respectfully submitted,
(Signed) **Eugene Haanel,**
Director of Mines.

Resolution Before House of Commons.

After a thorough consideration of all the facts and conditions a resolution was submitted to Parliament by the Honourable the Minister of Mines, March 21, 1910, as follows:—

> "Resolved that it is expedient to enable the Governor in Council to authorize the expenditure of a sum not exceeding fifty thousand dollars for investigating the processes used in the production of zinc; for making experiments, and for any other purpose that may be deemed advisable for the promotion of the production and manufacture in Canada of zinc and zinc products from Canadian ores."

The resolution was adopted (March 21, 1910) and resulted in the subsequent enactment of a Bill authorizing the proposed investigation:—

Bill as Passed April 8, 1910

Copy

THE HOUSE OF COMMONS OF CANADA.

BILL 182.

An Act respecting the payment of bounties on lead contained in lead-bearing ores mined in Canada, and to promote the production in Canada of zinc.—

His Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

1908, C. 43 S. 1 amended. Amount of lead bounties.

1. Subsection 2 of section 1 of chapter 43 of the statutes of 1908 is amended by striking out the words "five hundred" in the last line thereof and substituting therefor the words "four hundred and fifty."

Grant in aid of the production of zinc

2. The Governor in Council may authorize the expenditure of a sum not exceeding fifty thousand dollars for investigating the processes used in the production of zinc, for making experiments, and for any other purpose that may be deemed advisable for the promotion of the production and manufacture in Canada of zinc and zinc products from Canadian ores.

Instructions to Mr. W. R. Ingalls, of New York.

Thereupon, the following instructions—in part—were issued:—

Copy

Mines Branch,
Department of Mines,
Ottawa,
June 7, 1910.

To
Walter Renton Ingalls, Esq.,
505 Pearl Street,
New York, N.Y.

Dear Sir,—

You are hereby authorized to inaugurate and carry through an investigation for the discovery or development of a method for the economic treatment of the mixed zinc sulphide ores of Canada in the production of metallic zinc of a marketable zinc product.

The following recommendations made by you regarding the conduct of the investigation are approved, and are to be adhered to:—

1st. That you devote personal attention to all schemes that may be presented to this office in the interest of the problem to be solved.

2nd. That it is specially agreed, that no invention that may result from this investigation be patented in the Dominion of Canada, but that rights may be reserved as to other countries.

3rd. That all possible work in connexion with this investigation be done in Canada.

4th. That such small scale experiments as would be most conveniently done by you outside of Canada be permitted to be done in such place as you may direct.

5th. To enable the Department to make statements regarding the progress of the inquiry, when required, it will be necessary that all plans for the investigation which may be recommended by you from time to time be forwarded to this Branch for approval, and that monthly statements of expenditure, covered by vouchers in duplicate, be made to this Branch to meet the requirements of the Auditor General.

I am Sir,

Yours very truly,

(Signed) **Eugene Haanel,**

Director of Mines.

Accepted, June 10, 1910.

(Signed) **Walter Renton Ingalls.**

Pending Processes for Treating Zinc Ores.

The undeveloped processes mentioned in the Summary Report for 1909 (pp. 4 and 5), for the reduction or treatment of zinc-lead and zinc-lead-silver ores, are still in *status quo*. A letter dated July 4, 1910, from Mr. F. W. Harbord, the eminent metallurgist of London, England—who had been commissioned by the Department of Mines to investigate and report on the De Laval, Côte and Pierron, Sulman-Picard-Hommel, Kermode, and Ferguson processes—indicates that none of the zinc processes he had been engaged to study are, as yet, ready for investigation. And from the fact that since the date mentioned no further communication has been received, it is safe to conclude that, no further progress has been made.

EXPLOSIVES.

On page 7 of the Mines Branch Summary Report for 1909, appears a general statement under the title "Accidents in Mines, Caused by Explosives"; and this was supplemented by a detailed report by Mr. J. G. S. Hudson, on page 124. From the information set forth in that report, it was evident that Canada was greatly in need of an Explosives Act, to regulate the manufacture, storage, importation, and testing of explosives; and the necessity for immediate legislation was intensified during 1910, by three very serious explosions—attended by deplorable loss of life. The first disaster was the explosion of "Virite," which occurred March 8, 1910, at the works of the General Explosives Company of Montreal, Ltd., situated in Hull, Que.; the second was the explosion, July 11, 1910, of so-called "Blasters' Friend," at Sand Point, Renfrew county, Ont., and the third was the coal mine accident at Bellevue mine, near Frank, Alberta, on December 8, 1910. It is a lamentable fact, that in Canada during 1910, no less than 14 men were killed by explosions in explosives factories, while 10 were killed and 20 injured by explosions of magazines; whereas in England during 1909, where 40,000 tons of high explosives were manufactured—an amount far in excess of that made in this country—only 6 were killed and 12 injured in explosives factories; and 1 killed and 4 injured by the explosion of magazines. It may also be pointed out that, in Ontario during 1909, 49 per cent of the total number of fatalities in mines was caused by explosives.

In view, therefore, of the demand for legislative action, work was commenced on the preparation of data for drafting an Explosives Bill, adapted to the conditions existing in Canada.

In the framing of this Bill, the following salient points were maintained:—

(1) That as no Act was in force, the proposed Bill should be wide in its scope, as regards powers and conditions.

(2) That on account of the peculiar conditions existing in Canada, viz.: the great diversity of climatic conditions; the magnitude of the territory to be covered; and great diversity of operations to which explosives are applied, the Act would best accomplish its purpose, if operations under its general provisions were permitted only by sanctions issued under special Orders-in-Council; so that each case might be dealt with equitably, in accordance with existing conditions. For these reasons, the proposed Bill was made short and precise, so that it could be easily administered.

(3) Advisedly, the word "use" of explosives has been eliminated as far as possible from the Bill; with a view to preventing conflict of authority where provision has already been made under Provincial Mines Acts regulating the use of explosives. On railway, canals, or other construction works—not so governed—Federal Orders-in-Council will be issued for the proper use of explosives, so that adequate protection will be given to the men employed, and also to the general public.

(4) Provision has been made for the classification, authorization, storage, and transportation of explosives, and the issuance of licences to explosives factories, and storage magazines; also for the establishment of a technical explosives division: comprising inspectors, and staff of expert chemical examiners.

(5) Plans have already been submitted to the Public Works Department for the necessary buildings required for the proposed Explosives Testing Station; and estimates have been made for the proper equipment of the chemical and physical laboratories, and galleries for the Testing Station.

The most important section of the Bill is No. 18: under which are formulated the regulations governing the administration of the proposed Act. They are as follows:—

REGULATIONS.

19. The Governor-in-Council may make regulations—

(*a*) for classifying explosives, and for prescribing the composition, quality, and character of explosives;

(*b*) prescribing the form and duration of licenses, permits, and certificates issued under this Act, the terms and conditions upon which such licenses, permits, and certificates shall be issued, and the fees to be paid therefor;

(*c*) for regulating the importation, packing, and handling of explosives, and the transportation of explosives otherwise than by railway;

(*d*) for inquiries into the accidental explosion of explosives, and any accident caused by explosives;

(*e*) for the taking of samples of explosives required for examination and testing, and for the establishing of testing stations, and of the tests and other examinations to which explosives shall be subjected;

(*f*) prescribing the manner in which an explosive shall be tested and examined before it is declared to be an authorized explosive, and for determining to what examinations and tests authorized explosives shall be subject;

(*g*) to be observed by inspectors and other officers and employes charged with any duty under this Act, or under any regulations made thereunder;

(*h*) relating to the construction and management of factories and magazines;

(*i*) for the safety of the public and of the employes at any factory or magazine, or any person engaged in the handling, or packing of explosives, or the transportation of explosives otherwise than by railway;

(*j*) governing the establishment, location, and maintenance of factories and magazines, and the manufacture and storage of explosives;

(*k*) for the more effective carrying out of this Act.

2. All regulations made under this Act shall be published in *The Canada Gazette*, and upon being so published they shall have the same force as if they formed part of this Act.

The Explosives Bill was prepared by the Mines Branch, in consultation with Captain Arthur Desborough, H.M. Inspector of Mines, and in accordance with the advice of the Department of Justice. The provisions have, necessarily, been made broad and comprehensive, so that they will cover the wide range of conditions peculiar to Canada; and at the same time, harmonize with existing Provincial laws and regulations. The laws on the British Statute book, with regard to explosives—based as they are upon long and wide experience—have acquired international celebrity for their wisdom and equity, hence the best features applicable to Canadian conditions have been unhesitatingly embodied in the proposed Explosives Bill. A copy of Bill 79—"An act to regulate the manufacture, testing, storage, and importation of Explosives"—has been incorporated, as appendix III, on page 225.

MAGNETOMETRIC SURVEYING.

The investigation of magnetic iron ore deposits, which has been carried on since the formation of the Mines Branch, was continued during 1910. Two parties were employed in Ontario, New Brunswick, and Nova Scotia, examining magnetite deposits by the magnetometric method. Mr. Einar Lindeman extended the surveys already made near Bathurst, N.B., and at Bessemer, Ontario. He also made topographic surveys of these localities. Mr. Howells Fréchette made a magnetometric and topographic survey of a part of the Torbrook Iron Range, Annapolis county, Nova Scotia. In April, Mr. Lindeman delivered a short course of lectures on the Swedish methods of magnetometric surveying at the School of Mines at Kingston, Ontario; where they have recently installed an experimental table, and the regulation equipment for demonstrating the uses of the magnetometer.

CHEMICAL LABORATORY

The summary report of Mr. F. G. Wait indicates that, although the actual number of specimens examined and reported upon during 1910 was not quite so large as in 1909; yet, the staff in both the Sussex Street and Wellington Street branches has been fully employed. This diminution in the number of specimens

sent in is doubtless due to the issuance of the schedule of compulsory charges. The announcement that examinations and analyses were no longer *free* has evidently had a deterrent effect.

The plea, urged by the Chief Chemist, that the division of the laboratory system into two sections, with two buildings in different parts of the city of Ottawa, is neither conducive to efficiency nor the most economic work, is obvious: another powerful reason why the Mines Branch should be housed under one roof; with ample space not only for present work, but with adequate provision for future development.

An important event in connexion with the work of the Chemical Laboratory was the publication in August, 1910, of a report by Mr. Wait, giving an account of the detailed chemical analyses made in the Mines Branch laboratories during the years 1906, 1907, and 1908; incorporated with which is a description of the commercial methods and new apparatus used in the analysis of oil-shales—by Mr. H. A. Leverin.

DIVISION OF MINERAL RESOURCES AND STATISTICS.

The work of this Division comprises the collection of statistics of mining and metallurgical production throughout Canada, and the collection and recording of information respecting the country's mineral resources. The following statistical bulletins and reports have been issued from this Division during the year:—

No. 62. Preliminary Report on the Mineral Production of Canada during the calendar year 1909.

No. 58. Annual Report on the Mineral Production of Canada during the calendar years 1907 and 1908.

No. 79. The Production of Iron and Steel in Canada during the calendar year 1909.

No. 80. The Production of Coal and Coke in Canada during the calendar year 1909.

No. 85. The Production of Cement, Lime, Clay Products, Stone, and other Structural Materials in Canada during the calendar year 1909.

In order to cope with the growing work of the Division and to facilitate the more prompt publication of the revised annual reports of mineral production, the staff was increased during the year by the appointment of Mr. C. T. Cartwright, B.Sc., who spent some months during the summer collecting statistics of the production of brick, stone, and lime in Ontario.

The usual annual report of the mineral production during 1910 will, of course, be issued as soon as possible during the current year; but the preliminary report already published, and which is included as an appendix to this report, indicates very plainly the rapid development of Canada's mineral production.

The total output during 1910 is valued at upwards of $105,000,000, and shows an increase over the production of the previous year of more than $13,000,000. The increase is shown to have been well distributed amongst the more important ores and minerals produced in Canada.

The officer in charge of the Division refers in his report to the desirability of a special investigation as to the market in Canada, among manufacturers and others, for numerous mineral products, in various stages of refinement. Considerable quantities of mineral products which have undergone some process of treatment are being imported; while the crude mineral ores are being exported. A knowledge of the requirements of the Canadian consumer in this respect might be of great assistance in the development of numerous branches of our mineral industries. The value of such an investigation is fully recognized, and it will be undertaken during the current year.

DOMINION OF CANADA ASSAY OFFICE

In accordance with the plans outlined in my Summary Report for 1909, the Dominion of Canada Assay Office was transferred on July 26, 1910, to the commodious new quarters, prepared by the Public Works Department, at the corner of Granville and Pender Streets, Vancouver, B.C. And pursuant to instructions by the Honourable the Minister of Mines, I visited and inspected the establishment in November. The following is a copy of my report:—

Memorandum

Copy

OTTAWA, November 21, 1910.

HON. WILLIAM TEMPLEMAN, M.P.,
Minister of Mines.

In accordance with your instructions of the 15th ultimo, I visited and inspected the Dominion of Canada Assay Office at Vancouver, B.C., and beg to submit the following report thereon.

The reason for the establishment of the Assay Office at Vancouver was to furnish the mining communities of the Yukon and British Columbia with a convenient market for their gold, and to keep the trade accompanying the marketing of same in this country. To meet the purpose for which this office was established, it would, of course, be necessary to offer the same price for the gold deposited as that which the producer can obtain elsewhere, without extra expense or inconvenience. This at present is not the case.

A great change has taken place in the mining conditions in the Yukon since the Assay Office was established; and especially in regard to the transportation of the gold output, since it can now be shipped by registered mail from Dawson to Ottawa or to San Francisco at the same expense as to Vancouver, viz., $1.25 per thousand dollars value.

The express rate, which formerly was the only means of transportation, is $9 per thousand dollars value from Dawson to Vancouver, $3.50 from Vancouver to San Francisco, and $3.75 from Vancouver to Ottawa.

The charges imposed at the Ottawa Mint and the different institutions in San Francisco purchasing gold are the same, namely, one-eighth of one per cent less on gross value of gold deposited than at our office, which places our assay office in an unfavourable position regarding amounts of bullion likely to be deposited, as evidently producers will bring their bullion to markets paying highest prices.

It is generally recognized that Vancouver should be the point to successfully intercept the gold output of the Yukon, preventing it from being marketed in a foreign country. As it takes at least a fortnight longer to get returns from Ottawa to Dawson than if marketed in Vancouver, the only gold, therefore, likely to be shipped from the Yukon or British Columbia direct to Ottawa would be that for which the proceeds were required in eastern Canada.

One of the chief arguments made for the establishment and continuance of the Assay Office at Vancouver is that the marketing of the gold is accompanied by increase of trade. The following facts, personally verified by me during the three days of my stay, confirm the reasonableness of the view:—

HAZELTON, B.C.,
October 19, 1910.

THE MANAGER,
Dominion Assay Office, Vancouver.

DEAR SIR,—

By this mail I am forwarding you under separate registered covers two parcels containing gold dust and gold amalgam.

The dust I value at about $1,025, the amalgam at about $450. Kindly have same realized, forwarding proceeds to Messrs. Wilson Bros., Wholesale Grocers, Victoria, B.C., and the certificate to me.

Trusting same will reach you safely,

I remain,

Yours truly,

(Signed) **R. S. Sargent.**

Cheques in different banks were deposited by the Manager for the total sum of $40,000, against which cheques would be issued in payment of supplies purchased in the city. Two miners deposited about $17,000 worth of bullion and stated that they intended to spend the winter in Vancouver and invest their money there as opportunity offered. Had this money been deposited either in Seattle or San Francisco, it would have been lost to this country.

The amount of business, however, transacted is only a fraction of the business which this office ought to be transacting at this season of the year, with the result that a large amount of the trade and financial prestige which accompanies the marketing of the output of our gold mines is being reaped by a foreign country. This might to a certain extent be remedied by placing this office to a limited extent on the same footing in regard to charges as the Ottawa Mint and the different institutions in San Francisco, viz., that the charges remain the same as they are at present on all bullion received from British Columbia, Alberta, and Alaska, but that the charge of one-eighth of one per cent on the gross value of the bullion be not imposed on gold bullion from the Yukon on which the royalty or export tax has been paid.

The Assay Office was transferred on July 26, 1910, from rented premises on Hastings Street (where the rent had been gradually increased from $100 to $400 per month) to quarters which had been prepared by the Public Works Department in the Government building at the corner of Granville and Pender streets, according

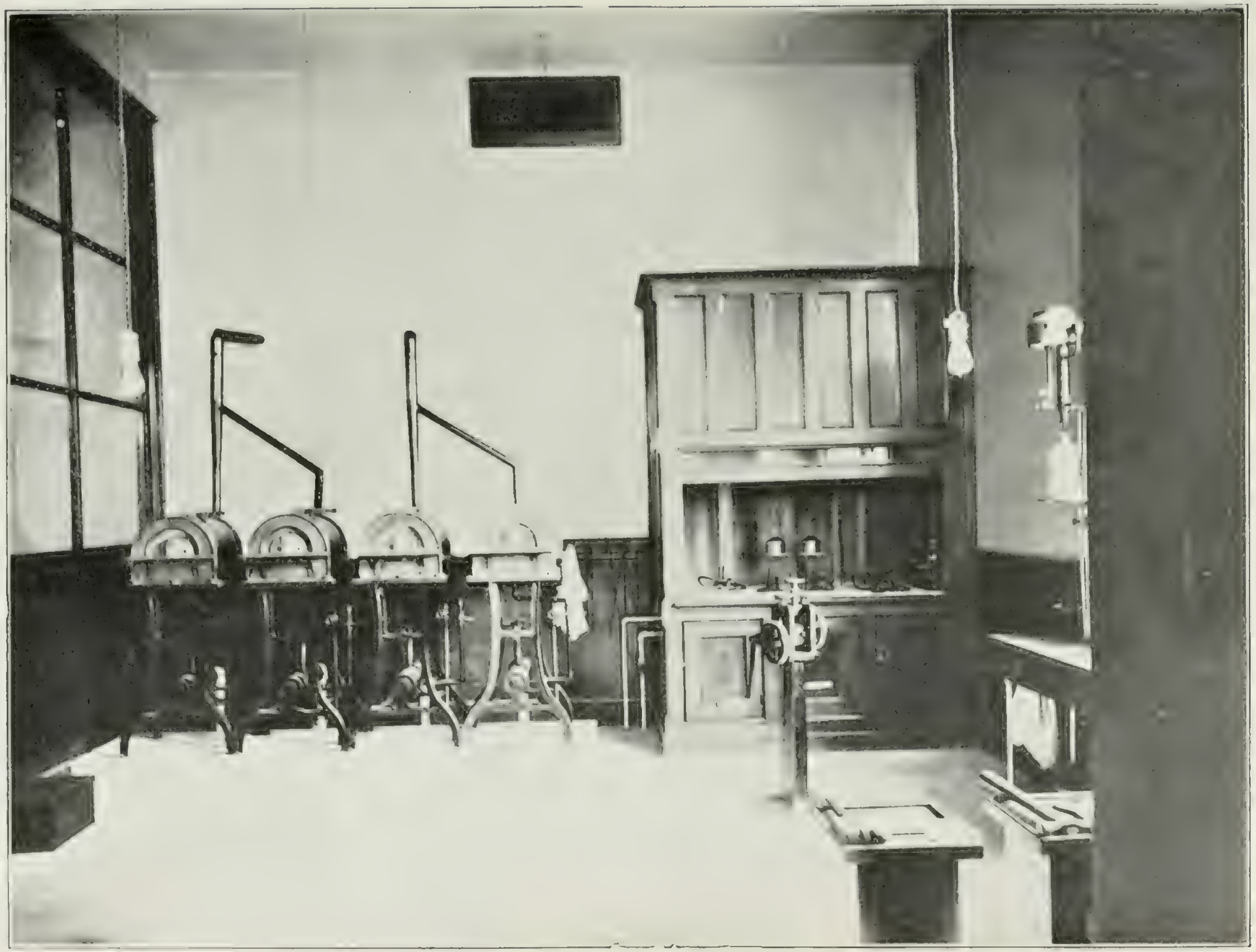
Dominion of Canada Assay Office: Corner Granville and Pender Streets, Vancouver, B.C.

Vestibule.

Receiving Office.

Safe Vault.

Melting Room.



Muffle Room.

to plans showing the division of space and position of balances and apparatus, which were forwarded to me and received my approval before the alterations necessary for permanent quarters of the Assay Office were proceeded with.

The building is located on one of the most central and prominent corners in the business section of the city, adjacent to all the banks, express offices, post-office, railway station, and docks, and the Assay Office has accordingly been fitted up in keeping with its surroundings and the class of business being transacted, viz., the purchase of gold bullion. The building was in very bad condition prior to the alterations, it having been necessary to renew the floors, which was done with reinforced concrete, instead of wood joists and boards as formerly. In fact, all the wood work had to be replaced, as it was completely decayed. The overhead beams carrying the top floors were also rotten and were replaced with steel girders, which permitted a great improvement being made, viz., the removal of a number of columns. In the old windows there was about as much wood as glass and artificial light had to be used during the day, but with the new windows there is not a better-lighted building now in the city. The sanitary arrangements were also in bad condition and had to be entirely renewed and the electric wiring had all to be renewed and placed in conduits. A great improvement has also been made in connexion with the entrance. Formerly there were a couple of steps inside of the door which wasted considerable floor space; but by building the steps out to the lot line the top step is now on the floor level outside the door. Considerable space was also gained by making the two corner doors into windows and by making one window on Granville street into an entrance.

The largest item of expense, however, was the building of the heavy wall (in which there are 132,000 bricks laid in cement) between that section in the building allotted to the Assay Office and that of the other departments, so that the Assay Office would be absolutely self-contained; the foundation of the wall is on hard pan beneath the level of the basement floor, and extends to the roof of the building and part of it above the roof, as it contains the two ventilating shafts and the six flues with which the furnaces are connected.

The entrance to the Assay Office has an outer gate or steel grille and an inner heavy oak door with glass panels. The main corridor is finished with a marble dado 4′-6″ high, and access to the work rooms and bullion vault is shut off by a heavy trellis-like steel screen, which extends from the top of the dado to the ceiling. There are six rooms, viz., the general office, melting, muffle furnace, balance and manager's rooms and a room for the depositors from where they can look through the steel screen into the melting room and see their bullion melted. The floors of the corridor, depositors' room, and general office are laid with tile and the floors of the melting and muffle furnace rooms with concrete, and those of the balance room and manager's room with hardwood.

The furnace rooms are kept cool by an electric suction fan connected with a flue, the outlet of which is above the roof of the building, the capacity of the fan being sufficient to change the air in the rooms every four minutes.

The table in the balance room on which the scales are placed stands on concrete points projecting from a concrete pillar, the foundation for which is on hardan beneath the level of the basement floor.

The manager's office is situated directly opposite the receiving counter, with an uninterrupted view of everything passing to and from the vault.

The vault is electrically protected, it being lined with two sheets of steel riveted together with a wood liner between, grooved lengthwise at intervals of three-fourths of an inch, into which the electric wires are placed. There are also grooves running crosswise at each end of the wood liners for the connecting wires, which in turn connect with a switch situated just outside of the vault door. The latter is also electrically protected, glass doors into which wires are moulded closing over the vault door and connected up on the same principle. Any interference with the vault would ring a gong at the institution with which the electric protection is connected.

The motor and high pressure blower for supplying the blast for the furnaces are located in the basement and the crusher and pulverizer in the melting room, both being driven by belts leading through the floor from a shaft in the basement.

The staff of this office is made up of a manager, two assayers, one melter, one computer-bookkeeper, and one assistant melter-janitor, who perform their work in an exceedingly satisfactory manner. The capacity of the office with the above-mentioned staff would be about one and a half million dollars per annum. By omitting the charge of $\frac{1}{8}$ of one per cent on the gross value of gold bullion deposited from the Yukon, which has paid export duty, it is likely that the total amount deposited per annum in our office would reach this amount. The amount of deposits for 9 months for the year 1908 was $1,478,893.74—the last year of express transportation. The decrease since then is due to transmission of bullion by registered mail, as explained. With this amount of deposits the permanent staff would have ample work to keep them fully employed during the balance of the year making proof gold, grinding up, amalgamating, and cyaniding slag, treating silver, making cupels, silver discs, etc.

I may here mention that there is a staff of nine in the United States Assay Office at Boise, Idaho, and they treated during the year deposits amounting to $837,031.05. At the United States Assay Office at Carson, Nevada, there is a staff of seven and the deposits for the year at that institution aggregated in value $739,570.01, showing that the policy of the United States Government is to maintain institutions so as to give the business community in the region where the gold is obtained the benefit of the trade accompanying the marketing of same, and at the same time provide a convenient market for the output of the mines.

The following shows the business done at this office since the commencement of the current fiscal year, viz:—

Number of Deposits.	Weight.		Net value.
	Before melting Troy ozs.	After melting Troy ozs.	
327	33,287·50	32,660·35	$539,446.89

I have enclosed a specimen of each of the forms and books kept in this office and of the report and statement forms sent to me at Ottawa, to which the following is an index, viz:—

Books and Records kept in Office.

(1.) Interim receipt form, handed to depositor, to be returned endorsed when he obtains settlement.
(2.) Letter of Credit cheque, drawn on Bank of Montreal, Ottawa, issued in settlement of bullion deposits.
(3.) "Melt book," giving weights of deposits before and after melting and after clip, etc.
(4.) "Register of clippings," giving weight of clip before and after assay, etc., etc.
(5.) "Disbursements and credits for the purchase of gold bullion," from which can be seen at a glance the balance of credit.
(6.) "Assay record," details of fineness, etc., relating to each assay.
(7.) "Source, weights, and value of gold bullion deposits," in which the deposits are classified under the different districts, and showing weights before and after melting and net value.
(8.) "Gold bullion deposits"—a complete record of all transactions.
(9.) Order form issued when supplies are purchased locally under "Contingent Account."
(10.) Memorandum of gold bullion—certificate of assay.

Reports, Statements, etc., forwarded to me at Ottawa.

A. Manager's Report—"Deposits of gold bullion"—a complete record of all transactions (sent weekly).
B. Assayers' Report—"Assay record"—details of fineness relating to each assay (sent weekly).
C. Melter's Report—in which deposits are classified under the different districts, showing the description of bullion, weights before and after melting, and loss per cent (sent weekly).
D. Form No. 13—"Attendance register" (sent monthly).
E. Statement of Disbursements—Contingent account (sent monthly).
F. Abstract of Cash Statement, showing total receipts and expenditure and balance at credit under Contingent Account (sent monthly).
G. Estimate of contingent expenditure (sent monthly).

I have carefully investigated the feasibility of adding to the functions of the Assay Office, by requiring the staff during slack times to do general analytical and assay work, and have come to the conclusion that this is impracticable for the following reasons:—

1st. There is no space in the Assay Office which could be allotted to this work.

2nd. On consultation with a number of mining engineers in Vancouver and Nelson, I find that there is a feeling against converting the Assay Office into a general chemical laboratory. It has, moreover, been stated, notably by Mr. Fowler, that the miners would not avail themselves of the services of the assayers of our office, but would prefer to have their assays made by the professional assayers, who have given thorough satisfaction,

and that the attempt to do general assay work would militate against the usefulness of our Assay Office by the enemies it would create in the regular profession.

3rd. Outside work which might come to our Assay Office would come during the busy season, when our assayers could not possibly attend to it.

4th. If, by cancelling the $\frac{1}{5}$ of one per cent now charged on the gross value of gold deposited from the Yukon, the amount of deposits is increased to one and one-half million dollars per annum, the staff will be fully occupied throughout the year.

Respectfully submitted,

(Signed) **Eugene Haanel,**

Director of Mines.

DESCRIPTION OF ASSAY OFFICE ROUTINE.

The following is a descriptive sketch of the regular routine and operations in the Assay Office prepared by the Manager (Mr. G. Middleton):—

The manager receives and weighs in the bullion, the weighing being checked by the computer-bookkeeper, a specimen of the depositor's signature is taken and he is handed an interim receipt, to be returned endorsed when he receives cheque in settlement and certificate of assay. The bullion is placed in a box on which there is a frame for a number card, the box is then locked and a card placed in the frame on which has been written the number assigned to the deposit and by which it is identified during the different operations through which it passes and appears in all records connected with the same. The bullion box is handed to the melter, opened in the melting room, and the bullion transferred to crucible in the presence of the manager or whom he may appoint, the necessary flux added, then melted and thoroughly stirred so that the bullion will be homogeneous, then poured into mould, the resulting bar cleaned, dried, and stamped with melt number. The slag from the melting of deposit is crushed, then pulverized and washed, and the granules recovered are cupelled, weighed, and included in the weight of deposit after melting.

Clippings for assaying purposes are taken from a top and a bottom corner of the bar at diagonal points, after which the bar is weighed on a balance for that purpose and the weight stamped on bar. The clippings are weighed and charged by manager to assayers while assay is being made, then returned to manager, weighed and included in the weight of deposit after melting, the loss in weight by assaying being seldom more than the one hundredth part of an ounce; two assays are made by each assayer (two), making four checks, and these checks must all agree to within 0·16 of a part per 1000 parts, otherwise the bar has to be remelted and re-assayed. A proof to check results accompanies each assay made. A report to the manager on form provided for the purpose is then made by each assayer of the proportion contained per thousand parts of fine gold, of fine silver, and of base metal, gold being reported to the next quarter-thousandth part below and silver to the next half-thousandth part below.

The computation of the values are then made by the manager and computer-bookkeeper, each using a different formula; $20·6718 per ounce is paid for the fine gold contained in the deposit and the rate for the silver is regulated by market value.

The certificate handed to depositor contains particulars of the weight before and after melting, proportion of gold, or fineness, and value, proportion of silver, or fineness, and value, deductions, net value and value per ounce after melting. The Letter of Credit cheques issued in settlement are negotiable without charge at any bank in Canada.

Necessary proof gold, silver, and cupels are made during the winter months.

Abstract of Assay Office Returns.

During the calendar year ending December 31, 1910, 46,064·31 ounces of gold bullion, valued at $746,101.92, were received and assayed. These deposits were derived from the following sources:—

Source.	Number of deposits.	Weight.		Net value.
		Before melting.	After melting.	
		Ozs.	Ozs.	$ cts.
Yukon Territory	57	3,688·06	3,594·87	62,094.09
British Columbia	401	35,189·99	34,482·73	571,670.52
Alberta	1	34·03	32·59	595.51
Alaska	29	6,961·43	6,938·11	108,348.01
California	2	190·80	180·62	3,393.79
	490	46,064·31	45,228·92	746,101.92

Weight before melting	46,064·31	ounces.
Weight after melting	45,228·92	"
Loss by melting	835·39	"
Loss percentage by melting	1·8135	

The earnings of the Assay Office, as shown by the accountant's statement on page 42, were $1,017.35 for the year.

FIELD WORK.

Iron—

Mr. E. Lindeman, in the early part of the year, concentrated his attention on the completion of his investigation of the iron-bearing district in the vicinity of Austin brook, New Brunswick: making magnetometric and topographical surveys.

Mr. Howells Fréchette was occupied during the summer, investigating the northwestern portion of the Torbrook iron ore deposits, in Annapolis county, Nova Scotia, for the purpose of determining the position of the ore beds, and, if possible, to ascertain whether the ore—due to multiple folding—approaches the surface within workable distance at other points than the present known lines of outcrop. Later in the season, he visited the magnesite deposits in Argenteuil county, Quebec.

In addition to his field work, Mr. Fréchette devoted considerable time to the revision of reports, and the preparation of notes and memoranda in answer to inquiries received by this office.

Copper—

Dr. Alfred W. G. Wilson spent the early part of the year visiting the localities and mines in the United States, where copper ores similar to those found in Quebec and other parts of eastern Canada are mined and smelted. It was considered that direct knowledge of mining methods and processes employed by the successful American companies would be an advantage in the preparation of that portion of the proposed monograph on the Copper Industry of Canada, which relates to the mines and prospects of Quebec and the Maritime Provinces. After an interval of office routine work at Ottawa, Dr. Wilson visited western Ontario, and in the autumn, the Provinces of New Brunswick and Nova Scotia, where all

available information was gathered respecting the past work and present condition of the copper ore fields in these districts. Before returning to Ottawa, Dr. Wilson paid a visit to the copper and sulphur ores and pyrites fields of Newfoundland; from whence cupriferous ores have been shipped to Wales, Great Britain, and the United States for more than twenty years. The geological conditions under which the ore bodies occur are similar to those in Nova Scotia; but development work and exploration are much further advanced, hence the advantage of a comparative study of those two fields.

Molybdenum—

Professor T. L. Walker, Ph.D., of the University of Toronto, continued his study of the Canadian deposits of molybdenite, confining his researches in the early part of the season to Ontario and British Columbia, concluding with the examination of some deposits in New Brunswick and Quebec. In one locality in New Brunswick, he discovered a hitherto unknown occurrence of wolframite. This mineral, when pure, contains about 60 per cent of tungsten, a metal for which there is at present a great demand. It is extensively used in the manufacture of filaments for incandescent electric lights, also in the alloying of steels for high speed, cutting tools.

Tin and Silver-Cobalt—

Mr. L. S. H. Cole, immediately after his appointment on the staff—August, 1910—was sent to Arnprior to investigate a reported tin deposit. The property on which the tin ore was reported to have been found showed no indications of the presence of this metal, but carried only a little zinc blende in calcite. He spent the latter part of the year obtaining information regarding mining operations in the Cobalt and Porcupine districts of Ontario; having special regard to methods of concentration of the silver-cobalt ores now in use in the Cobalt camp; and subsequently prepared a map (No. 94) showing the Cobalt, Gowganda, Shiningtree, and Porcupine districts: a copy of which is incorporated at the end of this report.

Mica—

Mr. Hugh S. de Schmid was engaged during the summer of 1910, gathering data for a revised, enlarged, second edition of the Mines Branch monograph on mica, published in 1905. He visited over 200 mica properties in Ontario and Quebec, and obtained much information on this important subject. A large proportion of the mines visited closed down some years ago at the time of the depression in the mica market and have not since been reopened.

Operations in Quebec were found to be comparatively at a standstill.

In Ontario, on the other hand, more activity was being displayed, and many old mines were in process of re-development.

A special feature of this investigation is the compilation of a new key map, showing the geographical location of the various mica deposits, and the extent of the mica industry throughout the Dominion.

Building Stones—

Professor W. A. Parks, Ph.D., of the University of Toronto, was engaged to investigate "The Building and Ornamental Stones of Canada."

The field work in Ontario for the preliminary report on the subject has been completed, and will be published in 1911. In addition to a study of the quarries in Ontario, Dr. Parks spent some time in the granite and marble areas of Vermont, and the slate region of western New York; also the quarries of the Missisquoi Marble Co., Philipsburg, Que. During this field work, numerous samples—representative of the various stones—were collected, and tests are being made with a view to determining the physical characteristics, in order to ascertain the commercial uses to which the stones can be most economically applied. These tests include crushing strength, porosity, ability to resist heat and frost, and manner in which the various stones chip and cut, etc.

Peat—

Mr. A. Anrep, Jr., the Swedish expert in charge of the Government peat plant at Alfred, Ont., started out-door operations there in May, and during a period of 50 days manufactured 1,600 tons of peat-fuel. Subsequent to this, he surveyed the Holland peat bog near Bradford, Ont., probably the largest in the Province: covering 14,641 acres.

Explosives—

Captain Arthur Desborough, H.M. Inspector of Explosives, London, England, visited the explosives factories of the Dominion: making an exhaustive study of the conditions peculiar to Canada. A report, setting forth his views, and accompanied by recommendations for legislatively regulating the manufacture and use of explosives, was published June 14, 1910. A reprint will be found on page 120.

Mining Data—

Mr. J. G. S. Hudson, in the early part of the year, was engaged in the gathering and compilation of statistics on explosives, and on accidents in mines. During part of the summer season, he accompanied Captain Desborough on a tour of inspection and investigation of the explosives factories in the Dominion. In addition to this work, he investigated the explosion of "Virite" which occurred on May 8, 1910, at the works of the General Explosives Company, Montreal, Ltd., situated in Hull, Que.; the disaster (July 11, 1910) with "Blasters' Friend," at Sand Point, Renfrew county, Ont., and the serious coal mine accident on December 8, 1910, at Bellevue mine, near Frank, Alta.

GENERAL CONSIDERATIONS.

A recapitulation of the main aspects of the work done by the Mines Branch during 1910 would show that, considerable work of an essentially practical character has been accomplished: in the investigation of the mineral and metal resources of the country and in the demonstration of economic methods of utilizing them commercially. This work would have been greatly accelerated had it not been for the very serious disadvantage under which the Executive of the Mines Branch has laboured, owing to the operations of the various subdivisions being necessarily conducted in five different parts of the city of Ottawa, instead of all being —as far as possible—under one roof. The headquarters were large enough in 1901 —when

the Mines Branch was established—but in 1910 are altogether inadequate to accommodate the greatly increased technical staff. The present divisional locations are as follows:—

(1) Headquarters—Director's offices; Statistical Division; Explosives Division, and general laboratory—Wellington Street.

(2) Chief Chemical Laboratory—Sussex Street.

(3) Fuel Testing Station, and Concentrating Laboratory—Division Street.

(4) Divisions of metalliferous and non-metalliferous ore deposits; mapping and drafting division; storage and distribution of reports—Sparks Street.

(5) Editor's and Accountant's Offices—Victoria Memorial Museum.

This enforced decentralization is a heavy handicap on the work of the Department, involving, as it does, great loss of time, waste of energy, and costly, unnecessary routine.

Inasmuch, therefore, as the development of the mineral and metal resources is of vital importance at the present stage in the industrial progress of the Dominion, it is imperative—in the interests of projected efficiency—that new, permanent quarters, capable (as far as possible) of housing the entire technical staff of the Mines Branch under one roof, should be provided without delay.

As mentioned in the introductory, there has been an unusual demand for the various technical publications of the Mines Branch: the total number of monographs, reports, bulletins, etc., distributed through the Post Office during the year being 38,650—an increase of 3,650 over 1909.

The progressive development of the mineral industry in Canada is shown by the fact that the total value of mineral products for the year 1910 was $105,040,958—an advance of $14,625,195 over the year 1909. The correspondence of the Statistical Division amounted to 7,727 communications received and sent; while the direct correspondence of my own office amounted to 4,750 letters received and 3,914 sent.

I have the honour to be, Sir,
Your obedient servant,

(Signed) **Eugene Haanel,**
Director of Mines.

REPORTS

ON

CHEMICAL LABORATORIES, STATISTICAL DIVISION, ASSAY OFFICE, FUEL TESTING STATION, METALLURGICAL LABORATORY, ETC.

CHEMICAL LABORATORY.

(a) Sussex St.
(b) Wellington St.

F. G. Wait, M.A., F.C.S.

Chief Chemist.

Both branches of the laboratory have been in constant operation during the year, and the time of the three members of the chemical staff has been fully occupied.

During the year, 750 specimens have been reported upon. This is a slight falling off from the number reported last year, and may be attributed to the enforcement of the schedule of charges to which reference was made in last year's report.

The laboratory is divided into two sections, established in separate buildings. Such a condition is not only not conducive to the most efficient service, but at the same time, makes it impossible to avoid duplication of the equipment, and some overlapping of work. It is confidently expected that such changes will be undertaken, if not completed, during the present year, as will bring the two sections, at present divided, into one, and that, fully equipped on modern lines.

It is not the place in a summary report to enter into lengthy details regarding the work done; but for the purpose of easy reference, the various materials operated upon may be classified under convenient headings, as follows:—

FUELS, comprising:—

I. *Peat*, 10 samples from:—
  (a) Ontario—
    (1) Alfred peat bog, in Alfred township, Prescott county.
    (2) Brockville bog, in Leeds county.
    (3) Brunner bog, in Ellice township, Perth county.
    (4) Komoka bog, in Lobo and Caradoc townships, Middlesex county.
    (5) Rondeau bog, in Harwich township, Kent county.

II. *Lignites*, 3 samples, from:—
  (a) Saskatchewan—
    (1) S.E. $\frac{1}{4}$ section 12, township 9, R. 28, west of 3rd.

(b) Alberta—
(1) Ferry Point, in section (?), township 43, R. 18, west of 4th.
(2) Tofield—

III. *Lignitic Coal*, from:—
(1) Driftwood creek, some 50 miles south of Hazelton, B.C.

IV. *Coals*, 16 samples, from:—
(a) Alberta—
(1) Leitch's collieries, at Passburg, township 7, R. 3, west of 5th—3 samples.
(2) Jasper Park collieries—along or near the proposed line of the G. T. P. Ry.—in the Rocky mountains—8 samples.
(3) Brule lake, Athabaska river.
(b) British Columbia—
(1) Bulkley River valley, Omineca Mining Division, "Sander's coal."
(2) From a point some 20 miles south of Hazelton—3 samples.

V. *Anthracite:*—

In addition to the analyses, outlined above, made upon Canadian material, some 63 samples of Pennsylvania anthracite were collected from the bins and stock piles of 14 Ottawa coal dealers, and the ash content of each sample determined. The object in view was to ascertain whether or not the Pennsylvania anthracite supplied to the public buildings in eastern Canada, fulfilled the requirements of the specifications on which tenders were based.

It was assumed that the coal sold in Ottawa was equal in all respects to that sent to other cities in Canada, from the same mines; and that the samples taken—all on one day, and from the dealers—would give a fair representation of the output of those mines.

The 63 samples comprised:—
(A) "Red" ash, 3 sizes—9 samples—average ash content 7·87 per cent.
(B) "White" ash, 5 sizes—54 samples—average content 9·06 per cent.
Average of 63 samples—"Red" and "White"—8·89 per cent.

Iron Ores, 28 samples, comprising:—

I. *Magnetite*, from:—
(a) Nova Scotia—
(1) Annapolis county—Torbrook mines—5 samples.
(b) Quebec—
(1) Chicoutimi county—20 miles from Chicoutimi village, in the Lake St. John district.
(c) Ontario—
(1) Lanark county—Lavant township—from the Wilbur mine—4 samples.
Iron Hill mine—1 sample.
Clyde River mine—1 sample.

II. *Hematite*, from:—
(a) Nova Scotia—
(1) Antigonish county—north of Brierly brook.
(b) New Brunswick—
(1) Northumberland county—from Allison farm, near Wayerton.

COPPER ORES:—

(a) Quebec—

Twenty-seven samples of cupriferous ores from the Eustis mine in the township of Ascot, Sherbrooke county, Quebec—collected by Dr. A. W. G. Wilson—have been assayed during the year. It is expected that other samples from this, and other districts, will be examined in the near future, and it has been thought advisable to defer extended reference to them until a later report.

(b) Ontario—

District of Nipissing—James township—Ottawa Belle claim, No. 7, R. 414—1 sample.

(c) British Columbia—7 samples, from the Gold Drop, Granby, and War Eagle mines, at Phoenix; and from the North Arm of Burrard inlet.

LIMESTONES:—

During the year, 3 samples of limestones, all from British Columbia—collected by Mr. O. E. LeRoy of the Geological Survey—have been examined by Mr. Leverin.

ORES OF MOLYBDENUM:—

Fifteen samples, all collected by Dr. T. L. Walker, from the undermentioned localities:—

(a) Ontario—

(1) Addington county—lot 2, con. xiv, of Sheffield township.
(2) Haliburton county—Cardiff and Lutterworth townships.
(3) Renfrew county—lot 8, con. vii—of Brougham township.
" " —Jamiesons mine—Lynedoch township.
" " —lot 22, con. ii—of Ross township.
" " —Hunt's claim—Mount St. Patrick.
(4) Vicinity of Lake Timagami.

(*b*) British Columbia—

(1) Highland valley, Ashcroft.
(2) Grande Prairie.
(3) Rossland, Giant mine.
(4) Texada island, Marble Bay mine.

ORES OF TUNGSTEN:—

Two samples of scheelite—calcium tungstate—from the town of Scheelite, situated 2 miles west of the workings of the Moose River Gold Mining Co., in Halifax county, N.S.

BRICK AND POTTERY CLAYS:—

Partial analyses of thirteen samples have been made during the year. Of this number, two samples were taken from William's clay bed at Petrolia, Ont.; two from Edrans, Man.; one from Asquith, Sask.; and one from Strathcona, Alta.

They were examined as to their suitability for brick and pottery ware, and also for cement making. None are worthy of special mention.

GYPSUM.

Thirty-two samples, collected by Mr. W. F. Jennison, from:—

(*a*) New Brunswick:—

(1) Albert county—8 samples.

(*b*) Nova Scotia:—

(1) Hants county—24 samples.

Quantitative analyses of these several samples were made.

OIL-SHALES:—

Thirty samples.

These were examined, and their yield of oil and of sulphate of ammonia determined.

They were taken at the undermentioned localities:—

(*a*) Nova Scotia—

(1) Antigonish county, Big Marsh—9 samples.

(*b*) New Brunswick—

(1) Albert county—6 samples.

(*c*) Ontario—

(1) From the vicinity of Collingwood.

(2) From the vicinity of Petrolia.

ROCKS AND MINERALS:—

The analyses of 21 samples of minerals and rocks have been completed and reported during the year—all by Mr. Connor.

These comprise:—

Asbestos, serpentine, diabase, and peridotite, from the Eastern Townships of the Province of Quebec;

Serpentine, augite-syenite, and pyroxenite from Olivene mountain, near Tulameen river, Yale district, British Columbia;

Chert, sericite-schist, and four specimens of contact metamorphic rocks, from Wheaton River district, Yukon Territory.

NATURAL WATERS:—

Six samples of natural water have been examined during the past twelve months. Two samples were taken from springs in Kamouraska county, Quebec; one from a well at Whitewood, Sask.; and three from springs situated on the west bank of Bulkley river, 20 miles above Hazelton, in the Omineca Mining Division, British Columbia.

GLASS SAND:—

Sand, thought to be suitable for use in glass-making, has been discovered at three different localities in Manitoba: shore of a small lake near Dauphin; from a 200 ft. boring at Ste. Anne des Chenes, Provencher county; and an undefined point on the shore of Lake Winnipeg.

Analyses of these samples have been made, and all were found to be remarkably free from oxides of iron, manganese, and other deleterious constituents.

FURNACE ASSAYS:—

One hundred and forty furnace assays for gold, silver, and platinum, have been made. Of this number, only 40 were accompanied by definite information indicating the locality of occurrence. The remaining 100 were sent in to the office and paid for, as commercial propositions.

The 40 specimens above referred to were distributed as follows:—

(a) Nova Scotia	4	samples.
(b) New Brunswick	1	"
(c) Quebec	9	"

(d) Ontario	12	samples.
(e) Saskatchewan	2	"
(f) British Columbia	12	"

MISCELLANEOUS:—

Under this caption are placed some 50 specimens for which written reports were furnished; and upwards of 250 others, for which an oral report was made, and of which no record was kept.

Of all these specimens, consisting mainly of rocks and minerals, requiring descriptions only, none were worthy of special mention, either by reason of their own character or through lack of sufficient data as to locality of occurrence.

Mr. M. F. Connor, B.A.Sc., and Mr. H. A. Leverin, Ch.E., have both rendered faithful and efficient service in carrying out the greater part of the work here referred to.

REPORT OF THE DIVISION OF MINERAL RESOURCES AND STATISTICS.

John McLeish, Chief of the Division.

The total value of the mineral production of Canada during the calendar year 1910, according to the returns collected by this Division, exceeded the sum of $105,000,000. The statistical record is, of course, not yet complete, but sufficient information has been received to show approximately the above result.

The statistics show very clearly that the year 1910 was one of exceptional activity in the successful exploitation of Canada's mineral resources. The production is made up from such a great variety of well established mining industries, that the record should be particularly gratifying, not only to those who are directly interested in the development of the mineral resources of the country, but also to the public at large, who indirectly profit thereby.

Not only is the increase over the production of the previous year a large one, having amounted to $13,209,517, or over 14 per cent, but an examination of the details of production shows that the increase has been fairly well distributed amongst the more important ores and minerals produced in Canada.

A Preliminary Report on the Mineral Production of Canada in 1910 has already been published and will be found reproduced as Appendix I to this report, page 163.

The actual work of the staff of this Division during the year 1910, has, of course, been mainly directed towards the collection of the statistics of mineral production in 1909 and the preparation and publication of reports with respect to the same. And while this work has been carried on in much the same manner as in previous years, nevertheless, much improvement has been made, not only in the method but in the extent and general efficiency of the published results.

Reference was made in last year's report to the fact that provision had been made for the addition to the staff of a mining engineer. This position was filled on May 9, by the appointment of Mr. Cosmo T. Cartwright, B.Sc., who had already had a number of years' experience in several of the mining camps of British Columbia.

As soon as convenient after the first of January, letters, and circular requests were sent out to the mining community throughout Canada from whom returns of production were desired; and towards the latter part of February sufficient information had been received and compiled upon which to base a preliminary report on the mineral production of Canada during the calendar year 1909.

The manuscript for this report was sent to press on February 24, and the printed report was received February 28, 1910. Copies were distributed at the annual convention of the Canadian Mining Institute held at Toronto, March 2, 3, and 4, 1910. The writer attended this convention, and read a short paper on the mineral production of Canada, thus placing before the mining community and the public—at the earliest opportunity—information concerning the extent of our mining output.

The annual meeting of the Nova Scotia Mining Society held at Halifax, March 15 and 16, was also attended. An endeavour was made at this meeting, in connexion with the subject of collection of mineral statistics, to show the desirability of having these records collected for the calendar year. At the present time the Provincial Department of Mines of Nova Scotia collects and publishes statistics of mineral production covering a fiscal year ending September 30. As a result of the discussion, the following resolution was submitted by Mr. T. Cantley:—

"I move that the Council be empowered to take what action it thinks necessary to bring to the notice of the local government the great advisability of having statistics end with the calendar year."

The motion was seconded by W. F. Jennison, and adopted.

The completed report containing the revised statistics of mineral production in Canada during the calendar years 1907 and 1908, was not received from the printers for distribution until the 16th of May, 1910. Parts of this report, however, had already been published in pamphlet form, and distributed during the previous year.

Some difficulty has been experienced in obtaining complete and prompt returns of production of products; such as stone, lime, clay products, etc.; many small producers being under the impression that it was not worth while reporting a small output, some thinking the information was required for purposes of taxation, and some failing to differentiate between the Provincial Bureau of Mines, and the Federal Department of Mines; while others were indifferent, or neglectful of correspondence. With a view to correcting these erroneous impressions and checking our lists of operators, Mr. Cartwright was instructed to visit a large number of those who had neglected to answer repeated correspondence. Some 81 cities, towns, and villages in Ontario were visited, and 109 different producers interviewed: information from remoter points being obtained, as well, by telephone or indirect inquiry. Mr. Cartwright reports that: "With hardly an exception, the most courteous treatment was received, and information was readily obtainable, in so far as those concerned were able to furnish it.

"The failure of many to report may be ascribed to several causes: carelessness; pressure of business; inability, owing to the fact that in many cases no records are kept; and though usually an estimate may be obtained, yet sometimes, even this is impossible, due to a fear that the returns are to be used for taxation purposes. Then, again, the Federal Department of Mines is confused with the Ontario Bureau of Mines—which also collects returns; while in some cases, where production had fallen off, it was not considered worth reporting.

"The majority of brick and tile makers whom I visited were very anxious to obtain any information which would aid them to improve their works and product.

"In the case of common brick, the prices are governed very largely by local conditions. Thus, while brick were being sold in Hamilton at $7.50 to $8.50 per thousand, and the demand steadily increasing; only forty miles distant, $6 to $6.50 per thousand was quoted, with sales on credit, and little demand.

"In districts where sand is plentiful and good clay deposits are scarce, concrete blocks and tiles are finding very extensive use, and in some cases are coming into serious competition with local brick yards. Throughout the Province there was a

most noticeable tendency to devote the plants entirely to the production of drain tile. This may very largely be attributed to the demonstrations by the Provincial Government of its use.

"The majority of the tile makers whom I visited reported a demand in excess of their capacity."

The separate publication of advance chapters of the final report inaugurated last year was continued, and in pursuance of the plan the following reports were prepared and sent to press on the dates indicated:—

The Production of Iron and Steel in Canada during the calendar year 1909—September 2.

The Production of Coal and Coke in Canada during the calendar year 1909—September 2.

The Production of Cement, Lime, Clay Products, Stone, and other Structural Material in Canada, during the calendar year 1909—November 14.

These were issued as advance chapters of the complete Report on the Mineral Production of Canada during the calendar year 1909, and were all received and distributed before the close of the year. The complete report was transmitted on December 22, 1910.

PROPOSED CO-OPERATION WITH THE CENSUS OFFICE IN THE COLLECTION OF THE MINING CENSUS.

Early in the year a proposal was made by Mr. A. Blue—chief officer of the Census—for the co-operation of this Division with the Census office in the collection of the Census statistics relating to mining, covering the year 1910.

Co-operation in this work appeared to be most reasonable, particularly in view of the fact that the Department of Mines already collects and publishes annual statistics of mineral production, the collection being chiefly by correspondence, and a duplication of the work by the Census office whose officers are not specially technically qualified for it would seem to be unnecessary.

In the United States where similar departments exist, such a co-operation was carried out in the collection of the census of 1900, and was then in progress in the collection of the census of 1910.

The Director of the United States census very kindly placed at our disposal copies of the special schedules that had been prepared for the joint use of the two departments concerned. After careful study of the subject some 25 special schedules were prepared, based mainly on the schedules already in use by this Division. These were adapted, however, to meet the requirements of the Census office, as well as the Mines Department. It was proposed that a plan of co-operation somewhat similar to that being carried out in the United States, between the U.S. Geological Survey and the Census Bureau at Washington, be entered upon. The special schedules were submitted, with the suggestion that they be adopted as special schedules of the Census office; that the work of collection be undertaken by the Department of Mines, acting under the authority of the Census Act; and that the statistics obtained be equally available to this Department for the preparation of its annual report on Mineral Production, and to the Census office, for the preparation of its special Census report on Mineral Production.

Unfortunately, the Census Act provides that the census shall be taken on a specified day in June, whereas the collection by this Department would require to be begun in January. For this, and other reasons, the proposal did not meet with the complete approval of the Census office, and after some consideration their request for our assistance and co-operation was withdrawn.

SUPPLY AND DEMAND FOR CERTAIN MINERAL PRODUCTS.

Numerous inquiries have been received during the year from prospectors and others desirous of knowing what market there is for various mineral products; many inquiries being also received from prospective buyers both in and outside of Canada, desiring to know where certain minerals or ores could be obtained.

Information as to the market for feldspar has been in special demand, and the following statement as to markets and prices may be of interest to those who have deposits of this mineral.

The annual production of feldspar in Canada at the present time is about 15,000 tons. This is practically all exported, and finds a market amongst the pottery manufacturers of Trenton, N.J., and East Liverpool, Ohio; the principal buyers being:—

The Potters Mining & Milling Company, East Liverpool, Ohio; The Golding Sons Company, East Liverpool, Ohio; The Eureka Flint & Spar Company, Trenton, N.J.; The Pennsylvania Feldspar Company, 706 Franklin Bank Bldg., Philadelphia, Pa.; and the American Feldspar Company, Barnard Station, N.Y. The total consumption in the United States is probably about 100,000 tons per annum.

The Canadian production is all shipped crude, and the producers get about $3 a ton on board cars.

Feldspar is used in Canada chiefly by manufacturers of pottery and enamel ware, and the consumption will probably amount to at least 1,500 or 2,000 tons per annum. These manufacturers, however, require their supplies finely ground, and frequently special grades, and as there are no suitable grinding mills in Canada, the ground spar is imported from the United States and costs from $10 to $14 a ton at Canadian points of consumption.

The principal Canadian users are: The Dominion Sanitary Pottery Company, St. Johns, Que.; The Thos. Davidson Manufacturing Company, Ltd., Montreal, Que.; R. Campbell's Sons, Hamilton, Ont.; The Standard Ideal Company, Ltd., Port Hope, Ont.; The Amherst Foundry Company, Ltd., Amherst, N.S.; The McClary Manufacturing Company, London, Ont.; The Canadian Trenton Potteries Company, Ltd., St. Johns, Que.; The Canada Pottery Company, Ltd., Iberville, Quebec.

Other products for which a market is sought include mica, molybdenite, gypsum, infusorial earth, titanite, actinolite, etc.

Inquiries have been received during the year for arsenical ores, wolfram, graphite, phosphate, salt, dolomite, mica, talc, asphalt, etc.

In the case of phosphate, although a considerable demand was apparent, in the opinion of Canadian producers the prices offered were too low to ensure profitable operations.

There are a considerable number of mineral products in Canada for which there is, perhaps, a fairly large demand in this country, particularly the non-metallics which are being mined and exported. The Canadian buyer usually requires his supplies to have undergone some process of treatment or refinement; while the producer has been content to sell his product crude, not being sure of a sufficient market to justify him in erecting a necessary plant. The mineral talc is an example of a product which was formerly all exported, while the Canadian consumption was being imported. Now, a grinding mill has been erected, and the Canadian product is finding a considerable local market. Feldspar is a product which is at present being altogether exported, although there is a considerable local demand, which is being filled by importation. There are many other products for which the extent of the home market is perhaps not very clearly understood. Amongst these products might be included high grade steels; abrasives—such as pulpstone, garnets, tripolite, corundum, etc.; barytes, magnesite, fluorspar, quartz, manganese, phosphate, and others.

A special investigation, amongst the manufacturers of paints, paper, sulphite, pulp, wallpaper, leather, enamelware, sanitary ware, etc., as to the market for these and similar products, would no doubt be productive of results of considerable value to the mining industry.

The routine correspondence of the Division during the year comprised about 1,384 letters sent and received, in addition to which, about 4,712 circular communications were sent out, and 1,631 received. Five reports of the Division were distributed, comprising about 10,000 copies.

REPORT COVERING THE OPERATIONS OF THE DOMINION OF CANADA ASSAY OFFICE, VANCOUVER, B.C., DURING THE YEAR ENDING DECEMBER 31, 1910.

There were 490 deposits of gold bullion, requiring 534 melts and 534 assays (quadruplicate check assays being made in each instance), including the assembling and remelting of the individual deposits after purchase into bars weighing about 1,000 troy ounces each and the assaying of same. The aggregate weight of the deposits before melting was 46,064·31 troy ounces, and after melting 45,228·92 troy ounces, showing a loss in melting of 1·8135 per cent. The loss in weight by assaying was 5·70 troy ounces (base and parted silver), the average fineness of the resulting bullion, viz., 45,223·22 troy ounces being 0·797 gold and 0·182 silver. The net value of the gold and silver contained in deposits was $746,101.92.

The gold bullion received came from the following sources, viz.:—

Source.	Number of deposits.	Weight. Before melting.	Weight. After melting.	Net value.
		Ozs.	Ozs.	$ cts.
Yukon Territory	57	3,688·06	3,594·87	62,094·09
British Columbia	401	35,189·99	34,482·73	571,670·52
Alberta	1	34·03	32·59	595·51
Alaska	29	6,961·43	6,938·11	108,348·01
California	2	190·80	180·62	3,393·79
	490	46,064·31	45,228·92	$746,101·92

Weight before melting	46,064·31	ounces.
Weight after melting	45,228·92	"
Loss by melting	835·39	"
Loss percentage by melting	1·8135	

Credits and Disbursements for the Purchase of Gold Bullion During the Year Ending December 31, 1910.

Unexpended balance—"Letter of Credit," January 1, 1910		$110,392.04
Credits established during year ending December 31, 1910		700,000.00
"Letter of Credit," balance written off at close of fiscal year, March 31	$ 49,878.40	
Disbursements for purchase of bullion	746,101.92	
Disbursements for purchase of nugget (on hand)—Gold Nugget Collection—per Cheque No. 608	626.58	
Unexpended balance, "Letter of Credit," December 31, 1910	13,785.14	
	$810,392.04	$810,392.04

Disbursements for the Purchase of Gold Bullion and Receipts from Sale of Same During the Year Ending December 31, 1910.

Disbursements for purchase of bullion on hand January 1, 1910, bars Nos. 524, 530, 536 to 548 inclusive		$ 11,169.64
Disbursements for purchase of bullion during year ending December 31, 1910—Cheques Nos. 549 to 607 inclusive, 609 to 612 inclusive, and 1 to 427 inclusive (Cheque No. 608 was issued in payment for nugget (on hand)—Gold Nugget Collection)		746,101.92
Proceeds from sale of bullion during year ending December 31, 1910	$750,455.99	
Value of bullion on hand December 31, 1910, bars Nos. 399, 400, 410, 411, 413, 414, 417 to 427 inclusive	7,514.60	
Difference in favour of this office		699.03
	$757,970.59	$757,970.59

Contingent Account for Year Ending December 31, 1910.

Unexpended balance, January 1, 1910		$ 155.51
Funds provided per official cheques Nos. 655, 751, 819, 10, 58, 194, 302, 398, 482, 570, 695, and 796		4,440.00
Amount remitted Receiver-General, per draft No. 169, at close of fiscal year, March 31, 1910	$ 99.37	
Expenditure during year ending December 31, 1910	4,470.74	
Unexpended balance, December 31, 1910	25.40	
	$4,595.51	$4,595.51

Contingent Expenditure During Year Ending December 31, 1910.

Rent	$2,400.00
Fuel (gas)	248.08
" (coal)	20.00
Light and power	155.17
Express charges on bullion	598.74
New equipment	110.50
Electric vault protection service	300.00
Transferring electric vault protection equipment to new quarters	206.00
Postage and telegrams	15.00
Telephones	68.50
Freight and cartage on assayers' and melters' supplies	11.82
Assayers' and melters' supplies (purchased locally)	206.05
Sundries	130.88
	$4,470.74

Proceeds from Residues Sold March, 1910.

Residue sold to Assay Office, Seattle, Wash. (bar No. A 4)	$351.89
Thirty-eight empty acid bottles sold to B. C. Assay & Chemical Supply Company, Ltd., Vancouver, B.C	5.70
	$357.59

Residues on Hand December 31, 1910.

Slag from melting of bullion (105 lbs. of which has been treated)	210 lbs.
Recovered from sweepings, slags, old furnaces, old crucibles, etc. (11·51 ounces)—value	$153.20

Twenty-seven empty acid bottles.

NOTE:—Residues (old furnaces, slags, old crucibles, etc.) are now treated in the office instead of being sold as formerly.

Miscellaneous Receipts.

Draft No. 185, in favour of Deputy Minister of Mines:— (Proceeds of sale of two old heating stoves and sundry office partitions)	$ 55.00
Draft No. 193, in favour of Deputy Minister of Mines:— (Proceeds of sale of old iron grilles, old case for balance, and old chain blocks)	59.00
Draft No. 196, in favour of Deputy Minister of Mines:— (A payment for melting 50 ounces native silver)	2.50
	$116.50

IMPROVEMENT OF EQUIPMENT.

A disc pulverizer for reducing slags to a fine powder was installed during the month of July.

The following shows the business done by the Assay Office since its establishment:—

Year.	Number of deposits.	Weight (troy ounces).	Net value.
1901-2 Fiscal	671	69,925·67	$1,153,014.50
1902-3 "	509	36,295·69	568,888.19
1903-4 "	381	24,516·36	385,152.00
1904-5 "	443	29,573·73	462,939.75
1905-6 "	345	21,050·83	337,820.59
1906-7 Nine months	269	20,695·84	336,675.65
1907-8 Fiscal	482	46,540·25	751,693.97
1908 Nine months	590	90,175·48	1,478,893.74
1909 Calendar	573	48,478·60	789,267.94
1910 "	490	46,064·31	746,101.92

(Signed) G. Middleton,
Manager.

December 31, 1910.

G. Middleton, Esq.,
Manager,
Dominion of Canada Assay Office,
Vancouver, B.C.

Sir,—

The following is a list of the assayers' supplies on hand, viz.:—

Silver nitrate crystals	1	oz.
Calcic chloride	⅓	lb.
Lead foil, C.P	55	lbs.
Cupels	about 4,000	
Nitric acid	10	Winchesters.
Sulphuric acid	¾	Winchester.
Zinc (mossy) C.P	½	lb.
Lead (granulated)	6	lbs.
Scorifiers, 4″	8	
" 2¼″	55	
Spare muffles	21	
" doors	5	
" supports	12	
" back stops	24	
" plugs	12	
Litharge	19	lbs.
Bone ash	about 10	"
Fireclay	" 15	"
Gold cornets	1·93	ounces.
" in solution	11·47	"
" proof	0·70	"
Silver	69·80	"

Yours obediently,

(Signed) A. Kaye,
Assayer.

December 31, 1910.

G. MIDDLETON, ESQ.,
Manager,

Dominion of Canada Assay Office,
Vancouver, B.C.

SIR,—

I beg to inform you that we have on hand in the Melting Department the following supplies, viz.:—

3 sets of linings with supports and covers complete, for No. 1 furnace.
2 " " " " " " " " " " 2 "
2 " " " " " " " " " " 4½ "
3 " " " " " " " " " " 7 "
1 Graphite crucible, No. 6.
6 Graphite crucibles, No. 10.
55 " " " 16.
12 " " " 30.
27 " " " 40.
50 " " " marked $\overset{o}{o}\overset{o}{o}$
2 Crucible covers, No. 16.
2 lbs. pot. nitrate.
40 lbs. carb. soda.
125 lbs. borax glass.

Your obedient servant,

(Signed) D. Robinson,
Chief Melter.

ACCOUNTANT'S STATEMENT.

(*a*)

The following is a statement of difference in value of assays between Seattle Assay Office and Dominion of Canada Assay Office, from April 1, 1909, to March 31, 1910:—

Paid for bullion at Dominion of Canada Assay Office, Vancouver	$750,121.60
Received for bars from United States Assay Office, Seattle	750,781.36
Difference in favour of Dominion of Canada Assay Office	$659.76

STATEMENT OF DEPOSITS OF GOLD AND EARNINGS.

Deposits of gold	$750,121.60
Earnings:—	
Value of residue sold United States Assay Office	$ 351.89
" " 38 acid bottles sold B. C. Assay & Chemical Supply Company	5.70
	$ 357.59
Difference between amount paid and received for bullion	659.76
	$1,017.35

(*b*)

The following is a statement of appropriation, receipts, and expenditure of Dominion of Canada Assay Office for the year ending March 31, 1910, and shows the unexpended balance to be $3,932.81:—

	Appropriation.	Expenditure.
Appropriation, 1909-10	$18,000.00	
Receipts per the foregoing statement	357.59	
Difference between amount paid and received for bullion	659.76	
Rent		$3,000.00
Fuel		292.55
Power and light		166.68
Postages and telegrams		79.68
Telephone		67.50
Express charges		613.74
Assayers' supplies		257.12
Printing and stationery		96.62
Premium on bonds		570.00
Contingencies		90.65
Electric burglar alarm service		300.00
Wages:—		
G. Middleton		2,500.00
J. B. Farquhar		1,800.00
D. Robinson		1,700.00
A. Kaye		1,500.00
G. N. Ford		1,000.00
G. B. Palmer		900.00
R. H. Filion		150.00
Balance unexpended		3,932.81
	$19,017.35	$19,017.35

Unexpended balance March 31, 1910, lapsed, $3,932.81.

(Signed) John Marshall,
Accountant.

FUEL TESTING STATION, OTTAWA.

B. F. Haanel, B.Sc.

I.

The installation of the peat gas producer and gas engine, purchased by the Mines Branch from Korting Brothers, Hanover, Germany, was completed about April 1, 1910.

The gas analytical laboratory was not completed until November, 1910, so that no complete tests could be carried out until after this date.

Previous to the installation of the gas analytical laboratory, three tests—to determine the consumption of peat per B. H. P. hour—were made with peat manufactured at Victoria Road peat bog. This peat had been manufactured some two years previous to the erection of the machinery at the fuel testing plant, and during this period was stored in a shed fully protected from the weather. It was consequently very dry, containing only 13 per cent moisture. But inasmuch as the producer was designed to gasify peat containing from 25 to 30 per cent moisture, the results of the tests with this peat cannot be considered as a criterion of the performance of the producer when working under proper conditions, viz., utilizing peat with from 25 to 30 per cent moisture.

The results, however, were excellent both as regards fuel consumption and behaviour of the fuel in the producer. The fuel consumption for the three tests averaged a little less than 2·2 pounds per brake horse-power hour.

After the completion of the gas analytical laboratory a complete 30 hour test was made with the peat manufactured at the Government bog at Alfred. The peat used during this test averaged 30 per cent moisture. During the entire test samples of gas were taken and analysed every hour. The calorific value of the gas was determined every 30 minutes by means of the Junker's calorimeter. Readings of both the voltmeter and ammeter were taken every 15 minutes. From these readings the effective horse-power of the engine developed during the test was calculated.

Before making the foregoing test, considerable time was spent in ascertaining the most suitable size to which it was necessary to crush the peat in order to obtain best results in the producer.

As determined by experimentation the peat should be of about the size of a hen's egg—for peat containing 30 per cent moisture. For peat containing less moisture larger sizes may be used, although the smaller sizes offer no difficulties to the operation of the producer regardless of the moisture content.

The satisfactory operation of the producer depends on the condition of the material fed to the lower zone, i.e., the material must be as free from volatile matter as is possible—since any tar distilled from the fuel in the lower zone cannot possibly be broken up, and, therefore, leaves the producer as a deleterious ingredient of the gas.

When these conditions are understood and the proper method of operating the producer learned it requires scarcely any attention from one day to another.

A few of the principal details of this test are as follows:—

	Dec. 6.
Producer cleaned and filled with peat	11·00 a.m.
Test started	11·00 "
Test terminated and producer cleaned and filled	5·00 p.m., Dec. 7.
Duration of test	30 hours.
Total fuel fired	4900 lbs.
Total ashes	153·5 "
Pounds coke lost through cleaning doors when poking and to be subtracted from total fuel fired	22·5 lbs.
Average load on engine	58·18 B.H.P
Consumption of fuel as fired, 30 per cent moisture per B.H.P.H	2·80 lbs.
Consumption of fuel per B.H.P.H. fired dry	1·87 "
Average heating value of gas	Gross 124 B.T.U. per cubic foot. Net 116 " " " " " " "

The producer was poked every two hours—the vacuum on the gas main throughout the entire run varied but little from 28 cms. of water (11″). No trouble was experienced during this run nor subsequent runs from clogging of the cleaning system.

An average sample of the total peat charged was taken for analysis and a gas sample taken and analysed every hour. The calorific value of the gas was determined every 30 minutes by means of a Junker's calorimeter.

Composition of the Gas by Volume.

The composition of the gas remained remarkably uniform throughout the later test.

The average composition was as follows:—

CO_2	9·9%
O_2	0·4 "
C_2H_4	0·4 "
CH_4	2·0 "
H	9·8 "
CO	20·6 "
N	56·9 "
	100·0%
Combustible gas	32·8%

In conclusion, it may be stated that the tests so far made have demonstrated that peat can be economically and efficiently utilized in producer gas engine plants, for the production of power. The operation of the Government *peat* gas producer plant has proven to be as simple as that of an *anthracite* producer gas plant: and may be economically substituted for those producer plants using imported coal—when the price of coal is in the vicinity of $3.50 per ton, and the price at which peat can be obtained is not more than $2 per ton.

II.

FUEL TESTING LABORATORY.

Edgar Stansfield, M.Sc., Chemist.

As a chemical laboratory was found to be an essential adjunct to the Fuel Testing Plant, a small room (17 feet × 11 feet)—the only one available—has been temporarily fitted up for the purpose. The work of this laboratory has been seriously hampered, and will be, until it is possible to provide suitable accommodation. Gas analyses and calorimetry—which require a room of constant temperature; furnace work, and all general chemical work in which heat is generated; weighings, etc.—which ought to be done in a clean room, free from chemical fumes liable to attack the balances; chemical work—which produces fumes; and the preparation of samples, which causes dirt, have all to be done in the same room. The accommodation urgently required includes: (1) a constant temperature room; (2) a general laboratory; (3) a room for furnace work; (4) a sample room; (5) a balance room and office, and (6) a store room. It would be possible but not desirable, to unite (2) and (1) or (2) and (3).

The equipment of the laboratory was begun in July, 1910, but it was not until September that the laboratory benches were installed, and that it was possible to begin chemical work there. The equipment includes the following pieces of apparatus, which were originally purchased for the coal tests carried out for the Mines Branch at McGill University, but which have now been installed in this laboratory: Bone and Wheeler gas analysis apparatus; Randall and Barnhart gas analysis apparatus; Boys gas calorimeter with meter and pressure regulator; Simmance and Abady carbon dioxide recorder; Fritz Köhler bomb calorimeter with accessories—including pressure gauge, Beckmann thermometer, and briquetting press; Bunsen combustion furnace with purifying and absorption trains; platinum crucibles, thermometers, and general chemical apparatus and chemicals. In addition to the above, the following have been obtained for the laboratory: two laboratory benches; a tile-topped table for furnaces; shelves; racks, etc.; Hoskins electric muffle furnace; Hoskins electric hot plate; International Instrument Company electric oven with thermo-regulator; Junker gas sampler; Junker gas calorimeter with meter and pressure regulator; two copper gas holders; two high pressure, oxygen gas cylinders; Brady gas filter with electric heating sleeve; induction coil; Sartorius analytical balance; Beranger balance; Sartorius box of weights; Fortin standard barometer with Kew certificate; Keiser & Schmidt pyrometer; Jewel water still; water blast pump with gauge; 16″ diameter, iron ball mill; electric lamp resistance board; and general chemical apparatus and chemicals. Water and electricity—both alternating and direct current—have been provided; and, as city gas is not at present available, gasoline gas is prepared for use in the laboratory by blowing air or producer gas through a small tank of gasoline.

The work which has been done in connexion with the laboratory, in addition to the considerable work of equipment, has included: tests on Blaugas; tests on Fisher's fuel economizer; tests of peat tar; micro-photography of coal dust

taken from the mine at Bellevue, Alta., after the explosion on December 9, 1910; 30 determinations of the calorific value of peat and coal; 65 determinations of the calorific value of gas; 65 analyses of gas; 20 determinations of tar and dust in producer gas; and a number of determinations of moisture, ash, volatile matter, etc., in peat, coal, and coke. The samples tested include: 21 samples of peat from the Government peat bog at Alfred, Ont.; 11 from the Holland peat bog at Bradford, Ont.; 4 from Walkerton, Ont.; and 4 sundry peat samples; 12 samples of coal from Edmonton; 1 from Pittsburgh; and 1 sample each of cannel and anthracite coal; 1 sample of gas coke.

THE ORE DRESSING AND METALLURGICAL LABORATORY

George C. MacKenzie, B.Sc.

During the summer and autumn of 1910, the Mines Branch installed a plant at the Fuel Testing Station, Ottawa, for the experimental concentration of low-grade, magnetic, iron ores. This installation consists of a Gröndal wet concentrating unit: comprising an ore crusher, ball mill, and two Gröndal magnetic separators. The machines are of standard, commercial size, the capacity of the unit—depending upon the character of the crude—being anywhere from 50 to 100 tons of ore per 24 hours.

This machinery is placed in the room originally intended for a repair shop at the Fuel Testing Station, and receives its motive power from the gas producer plant which is operated with peat fuel obtained from the Government bog at Alfred.

This machinery was installed with a view to proving the amenability of Canadian low-grade magnetic iron ores to methods of concentration carried out successfully in the United States, England, Sweden, and Norway. The process is both simple and effective, having for its objective the concentration or enrichment of the iron values; together with the elimination of various obnoxious minerals usually associated with low-grade ores.

The process of magnetic concentration, as applied to a certain inferior class of iron ores, has, to-day, a firmly established and well recognized value in the above-mentioned countries. The product is not only high grade, being eminently suitable for the production of the finer grades of iron and steel; but constitutes also a valuable auxiliary to the main supply of natural ores.

The United States leads all other countries in its resources of high-grade, natural iron ores; but notwithstanding this fact, several of the larger iron corporations in that country have found it exceedingly profitable to employ concentration methods in the utilization of low-grade ores. This is the more worthy of note when it is considered that iron and steel manufactured from these concentrated ores are competing successfully with iron and steel made from the natural and apparently cheaper ores.

About 17 per cent of the iron ores smelted in Canadian furnaces during 1909 was of domestic origin. This small proportion is due to the fact that, we have not as yet discovered merchantable deposits of sufficient magnitude to meet requirements.

The iron and steel companies of the Maritime Provinces, it is true, secure the major portion of their ore supply from Newfoundland; but the Ontario furnaceman is almost entirely dependent for his ores upon the American ranges of Minnesota and Michigan, and in 1909 he found it necessary to import from the United States over 71 per cent of the amount required.

While it is true the supply of high-grade merchantable iron ore in Canada is limited, there are in the Dominion enormous quantities of low-grade material not regarded as merchantable, and which have hardly been touched.

To render these impure ores in fit condition for the manufacture of iron and steel necessitates the application of a concentration process; and the fact that the vast majority of our low-grade iron ores are of the magnetic variety, suggests the adoption of magnetic concentration as the means whereby these ores may be utilized with profit.

With a view to showing the extent to which the magnetic concentration process would apply to Canadian ores, it will be illustrative to mention a few of the localities in which they are found.

The sulphurous magnetites occurring on the coast of British Columbia have hitherto been regarded as a doubtful asset, on account of their impurity. Many of these British Columbia magnetites contain copper in appreciable amounts, which might constitute a valuable by-product. The siliceous jaspilite ores of northern Ontario, and the more crystalline and sulphurous ores of the western and mid-eastern portion of the Province, present concentration problems of the utmost importance. The high sulphur ores of Quebec occurring along the Ottawa and Gatineau rivers, and the large titaniferous deposits found on both sides of the St. Lawrence river are worthy of exploitation as regards their profitable use in the manufacture of iron and steel.

The magnetic sands of the lower St. Lawrence river require more accurate investigation as regards their extent and amenability to concentration; and the recent discovery of large bodies of intermixed siliceous magnetic and hematite ores in New Brunswick offer additional problems, as also do the semi-magnetites of the Nictaux range in Nova Scotia.

After the completion of the magnetic concentration plant, the Mines Branch issued a circular letter calling attention to the installation; describing its purpose, and inviting those interested to send in samples of iron ore for testing purposes. All tests are made free of charge; but it is required that samples and specimens shall be delivered to the testing plant in Ottawa carriage paid. The replies to the circular letter received up to date have been most gratifying, and arrangements have been made for the testing of some 80 tons of ores received from different localities: in five, ten, and fifteen ton lots.

A list of the ores received up to date for testing purposes is as follows:—

TABLE I.

List of Iron Ores Received for Testing.

Name of Ore.	Locality.	Shipped by.	Weight of shipment. Tons.
Wilbur, No. 1, Run of mine.	Lots 3 and 4, con. XII. Lots 3 and 4, con. XIII. Township of Lavant, county of Lanark, Ontario.	The Ontario Exploration Syndicate, Wilbur, Ontario.	10
Wilbur, No. 2, Waste dump.	Lots 3 and 4, con. XII. Lots 3 and 4, con. XIII. Township of Lavant, county of Lanark, Ontario.	The Ontario Exploration Syndicate, Wilbur, Ontario.	5
Robertsville.	Lots 3 and 4, con. IX. Township of Palmerston, county of Frontenac, Ontario.	The Ontario Exploration Syndicate. Wilbur, Ontario.	5
Culhane.	N. ½, lot 21, con. VII. Township of Bagot, county of Renfrew, Ont.	Thos. B. Caldwell, Esq., Lanark, Ont.	3
Bathurst.	Lot 12, range XVII. Township of Bathurst, county of Gloucester, New Brunswick.	The Canada Iron Corporation, Limited, Montreal, Quebec.	15
Nictaux Torbrook, hematite vein.	County of Annapolis, Nova Scotia.	The Canada Iron Corporation, Limited, Montreal, Quebec.	15
Nictaux Torbrook, shell vein.	County of Annapolis, Nova Scotia.	The Canada Iron Corporation, Limited, Montreal, Quebec.	15
Goulais river.	Goulais River range. Township 22, range XII. District of Algoma, Ontario.	The Lake Superior Corporation, Sault Ste. Marie, Ontario.	15

As previously stated, the concentrating machinery is installed at the Mines Branch Fuel Testing Station, Ottawa, and is contained in a room 22′-0″ × 18′-0″, originally intended for a repair shop. The smallness of the room necessitated unavoidable crowding of machinery, and the operation of the plant is handicapped somewhat by this lack of space.

The process of operation is as follows: the crude ore is broken to about 1″, by an 8″ × 12″ Hadfield and Jacks solid steel crusher of the Blake type. This crusher is furnished with manganese steel jaws and cheek plates. From the crusher the ore drops to an elevator boot, and is picked up and elevated by belt and bucket elevator to an ore bin of about 1½ tons capacity. The ore bin delivers by ordinary roller feed to a 54″, Hardinge, conical ball mill. The mill is lined with hard iron plates, and takes a charge of iron balls or flint pebbles of from 1 to 1½ tons. A scoop feeder attached to the mill picks up a portion of the crushed ore from a feed box at each revolution; feed water being introduced to the feed box by a ¾″ pipe.

The finely ground ore flows from the ball mill to a 6″ × 48″ Frenier sand pump, which elevates the pulp a vertical distance of 10 feet, to the magnetic separators. The two, No. 5 Gröndal separators are operated in tandem: the first machine eliminating the major portion of the gangue, and the second re-concentrating the heads product from the first.

Concentrates and tailings are laundered to settling tanks, and are drawn off periodically through bottom discharge spigots. During the running of a test, samples of the crude ore are taken every fifteen minutes from the ball mill discharge, and samples of concentrates and tailings taken at the same time from the discharge spigots of the settling tanks.

The crude ore is weighed before crushing; but no attempt is made to dry and weigh concentrates and tailings; their weight being calculated from the weight of the crude, and the analyses of the crude concentrates and tailings.

Power is supplied by a 40 H.P. direct current, Westinghouse electric motor, connected to a generator driven by the gas engine in the adjoining fuel testing plant. The energizing current for the magnetic separators is supplied from the same source.

The amount of power consumed during a test is indicated by ammeters and voltmeters: readings being taken every fifteen minutes.

The amount of water used by the ball mill and the separators is recorded by ordinary water meters.

A PRELIMINARY TEST WITH GOULAIS RIVER ORE.

In November, 1910, the Lake Superior Corporation sent Mr. G. L. Michael to Ottawa with samples of Goulais River low-grade magnetite, for the purpose of consulting with officials of the Mines Branch with regard to methods of concentration.

The samples submitted by Mr. Michael consisted of crypto-crystalline magnetite, in a siliceous gangue. The ore exhibits a marked banded structure; bands of siliceous magnetite alternating with bands of non-ferrous siliceous material. The ore is typical of many of the northern Ontario low-grade iron ores; the crystallization being so fine that concentration can be effected only by fine grinding and wet magnetic concentration.

The samples, marked G. L. M. and L. L. B., weighed 75 and 50 pounds respectively. On account of the smallness of the samples, it was impossible to put the ores through the regular process; for they would have been lost in the Hardinge ball mill. They were, therefore, pulverized in a small laboratory ball mill, to a fineness of 80 mesh, and after grinding, fed by hand to the Gröndal separators.

Further difficulty was experienced in separating the ore, on account of the smallness of the samples. The separators, being of commercial size, were difficult to adjust to the comparatively small sized samples, consequently, a rather heavy loss of iron resulted.

Following are the results of the preliminary test:—

TABLE II.

Preliminary Separation.

Sample.	Crude Ore.		Concentrates.		Tailings.	
	Iron %	Insoluble %	Iron %	Insoluble %	Iron %	Insoluble %
G. L. M.....	37·45	47·00	60·27	17·3	19·87	71·28
L. L. B.....	35·00	52·00	54·87	24·2	14·8	77·40

Taking the above figures as a basis for calculation, the units of crude required per unit of concentrate, and the percentage of iron recovered in the concentrate are arrived at as follows:—

For Sample G. L. M.

$$\frac{60\cdot27-19\cdot87}{37\cdot45-19\cdot87}=2\cdot32$$ unit of crude required per unit of concentrate, and

$$\frac{60\cdot27\times100}{37\cdot45\times2\cdot32}=69\cdot3$$ per cent of iron recovered in the concentrate.

For Sample L. L. B.

$$\frac{54\cdot87-14\cdot8}{35\cdot2\ -14\cdot8}=2\cdot00$$ units of crude required per unit of concentrate,

and

$$\frac{54\cdot87\times100}{35\cdot2\ \times2\cdot00}=77\cdot8$$ per cent of iron recovered in the concentrate.

Because of the smallness of the samples submitted for testing purposes, the above results, although encouraging, show a heavy loss of iron in the tailings. It was advised, therefore, that a larger quantity of the ore should be sent in, to allow of a test being made under conditions more nearly approaching commercial practice. The Lake Superior Corporation, in compliance with the suggestion, have delivered 15 tons for treat ıent.

Complete results of the large test will be published in a later report.

MAGNETIC COBBING TESTS WITH WILBUR ORE.

The Exploration Syndicate of Ontario, operating the Wilbur iron mine, on the Kingston and Pembroke railway, conducted certain magnetic cobbing tests with Wilbur ore, December 1910, at the Kingston School of Mines.

As the Mines Branch had undertaken the work of making experimental tests with Wilbur ore by the Gröndal process, the Exploration Syndicate requested that the writer should attend certain of the cobbing tests in Kingston for purposes of consultation.

I was, therefore, instructed to proceed to Kingston and render such assistance as was possible, and the following is a report upon three cobbing tests made at the Kingston School of Mines.

Inasmuch as my absence from duty in Ottawa was limited to three days, it was impossible to do more than see the experiments fairly started, and then hand over the detail work to others. Hence, the report should be considered as a description only, of the general results obtained from the experimental separation of the ore, rather than a forecast of the conditions that will probably obtain in actual practice.

The tests were carried out at the mining laboratory of the Kingston School of Mines by certain members of the school staff, my presence being requested solely for consultation as regards the methods of experimentation to determine certain factors that control the production of merchantable concentrates.

During my stay in Kingston, I superintended the operation of Test No. 1; but had to return to Ottawa before the chemical analyses of the different products were completed. Arrangements were made that I should receive the details of chemical analyses when finished. Up to date, I have received the analytical results of three tests, and having been asked for a report upon the same, I append it herewith.

After consultation with Mr. R. R. Carr-Harris, and Mr. J. G. McNulty—the officials of the Exploration Syndicate of Ontario who were present during the tests—it was decided to experiment for the production of concentrates containing between 55 and 60 per cent of metallic iron, and in such a mechanical condition that they could be utilized in the blast furnace without nodulizing or briquetting; and for tailings containing not more that 10 per cent of metallic iron.

The exact mechanical condition of fineness of concentrated iron ores suitable for direct use in the blast furnace is a much debated point. One furnaceman may not object to a certain proportion of fines that will cause another unlimited trouble. Hence, the mechanical condition that will meet with general favour is difficult to determine.

It was, therefore, thought advisable to limit the proportion of fines in the experimental concentrates to a degree that should parallel as closely as possible the mechanical condition of the well known iron concentrates marketed by Witherbee, Sherman, and Company of Mineville, N.Y., U.S.A. This Company experience no difficulty in finding a sale for their product, which is of such mechanical condition that 65 per cent by weight is larger than 10 mesh.

Accordingly, the first or preliminary test was made with the crude broken to 1″ size, which it was thought would facilitate the production of concentrates possessing a mechanical condition well within the limit, as stated in the previous paragraph.

TEST NO. 1 ON RUN OF MINE, WILBUR ORE.

The ore was first broken to about 1″, and then sized over impact screens. Seven sizes were made in all; six sizes less than 1″, and one oversize. The several

portions of the sized crude were then concentrated separately by the Ball and Norton belt separator; making three products: heads, middles, and tails.

The following is a tabulated statement of the results of this test.

TABLE III.

Test No. 1 on Run of Mine: Wilbur Ore.

	Crude Ore.			Concentrates.			Middlings.			Tails.			Loss.	
Mesh size.	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%
40.....	42·5	7·1	43·1	26	61·2	65·8	....	.....	.....	14	32.9	5·5	2·5	5·9
16.....	21	3·5	42·7	13	61·9	59·7	....	.....	.....	6·5	30·9	6·7	1·5	1·5
8.....	34	5·7	43·2	25	73·5	54·2	....	.....	.....	8	23·5	10·1	1	2·9
¼".....	65	10·8	45·2	49·5	76·1	52·2	8	12·3	29·1	5	7·7	8·6	2·5	3·8
½".....	93	15·6	46	81·5	87·6	49·4	5	5·4	28·5	6	6·4	5·7	0·5	0·5
1".....	277	46·3	.....	240·5	86·8	50·3	22	7·9	.....	14·5	5·2	6·3	0·0	0·0
Over-size.	65	10·8	.....	52	.....	51·4	10	15·4	39·1	3	46	6·1	0·0	0·0
Totals..	597·5	99·8	45·8	487·5	81·6	51·75	45	7·5	32·7	57	9·5	7	8	1·3

It will be noted that the iron content of the concentrates is only 51·75 per cent, a figure too low to be regarded as at all satisfactory. On the other hand, the recovery of iron is good, there being 92·1 per cent of the original iron saved, and the mechanical condition well within the limit: showing 86·8 per cent larger than 8 mesh.

After I had received the analysis of the above test, I advised that for Test No. 2 the ore should be broken to pass ¾" or ½" screen; that certain adjustments of the separating machine should be made to allow the production of more middlings, and at the same time a loss of iron in the tailings to more nearly approach the limit of 10 per cent. By this means a certain proportion of lean particles that contained sufficient magnetite to cause them to enter the concentrate in Test No. 1, and thereby lower its iron content, would be allowed to escape as a middling product for subsequent retreatment.

That this advice was not followed is apparent from the following tabulated results of Test No. 2.

TABLE IV.

Test No. 2 on Run of Mine, Wilbur Ore.

The ore for this test was crushed to pass a $\frac{1}{4}''$ screen, then sized into four products, and separated.

—	Crude Ore.			Concentrates.			Middlings.			Tails.			Dust Loss.	
Mesh size.	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%
40 . . .	218	23·15	45·8	145·5	66·7	65·0	18·5	8·5	4·8	49	22·4	4·3	5·0	2·3
16 . . .	107	11·35	43·7	78	72·9	56·6	10·0	9·3	9·7	17·5	16·3	5·5	1·5	1·4
8 . . .	182·5	19·4	44·2	147	80·5	52·5	14·0	7·7	12·6	19·5	10·7	7·0	2·0	1·1
$\frac{1}{4}$ . . .	434	46·1	46·6	370	85·7	52·0	20·0	4·6	17·2	39·5	9·1	9·0	4·5	1·0
Totals	941·5	100	45·7	740·5	78·6	55·3	62·5	6·6	11·1	125·5	13·3	6·2	13	1·5

Concentrates produced from Test No. 2 were just over the lower limit of the desired iron content, but contained only 49·9 per cent of material larger than 10 mesh, and, therefore, might be objected to on account of their fineness. The saving of iron effected was very satisfactory, being 95·1 per cent of the original.

It is quite possible that concentrates of the general character produced from Test No. 2 would find a market, but it is believed that a more desirable and valuable product would result by limiting the primary crushing to say $\frac{3}{4}''$ or $\frac{5}{8}''$, and then making a larger proportion of middlings for subsequent re-treatment.

A third test was made on ore from the Wilbur No. 2 dump. This ore was taken from an old waste dump, and is of much lower grade than the run of mine.

TABLE V.

Test No. 3, on Ore from Wilbur Mine Dump, No. 2.

The ore was broken to 1″ and then sized, preparatory to concentration. The results of this test are as follows:—

—	Crude Ore.			Concentrates.			Middlings.			Tailings.			Dust Loss.	
Mesh size.	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%	Fe. %	lbs.	%
40.....	57	7·6	36·0	30	52·6	60·0	.....	.....	.....	22·5	39·5	3·9	4·5	7·9
16.....	29	3·9	33·1	17·5	60·3	49·0	4·5	15·5	9·2	6·0	20·7	4·1	1·0	3·4
8.....	46	6·10	34·9	32	69·6	45·0	7·5	16·3	15·4	6·0	13·0	5·5	0·5	1·1
$\frac{1}{4}''$....	67	8·8	36·8	46	68·6	45·3	14·5	21·6	18·7	4·0	5·9	6·2	2·5	3·6
$\frac{1}{2}''$....	191	25·3	37·0	157	82·2	41·3	26·0	13·6	22·0	5·0	2·6	4·3	3·0	1·5
1″....	365	48·3	37·1	315	86·3	40·2	23·5	6·4	26·6	23·0	6·3	4·9	3·5	1·0
Totals..	755	100·00	36·6	597·5	79·1	42·3	76·0	10·1	21·4	66·5	8·8	4·6	15	2·0

The concentration effected by this test is not satisfactory, the heads product containing only 42·3 per cent of iron. If any additional tests are to be made, the crude should receive preliminary comminution to at least $\frac{1}{2}''$, and the separating machine adjusted to make a larger middling product and allowing a heavier loss of iron in the tailings.

Summarizing the results of the above preliminary tests, it may be stated that, the production of concentrates having the desired iron content and mechanical condition will not be accomplished easily by the dry method of separation, unless the operators are prepared to allow a considerable percentage of iron going to waste in the tailings.

If an attempt is made to save over 90 per cent of the original iron, it will be found that the concentrates will be either of inferior iron content, or of such mechanical condition as to preclude their use in the blast furnace, without nodulizing.

On the other hand, if the cost of the crude delivered at the concentrating mill is sufficiently low, it may prove admissible to allow a loss of from 15 to 20 per cent of the original iron, in order to produce the desired concentrate.

The percentage of loss allowable will be controlled by the cost of the crude delivered at the mill, the cost of concentrating and the market price of the concentrates. It is impossible to offer even an approximate figure for the allowable loss without complete costs data, but it is suggested that this point should receive careful attention, as it will, in the writer's opinion, prove a vital one in the concentration of Wilbur ore.

WET MAGNETIC CONCENTRATION OF WILBUR ORES.

The following tests were made at the testing laboratories of the Mines Branch in Ottawa.

Test No. 1, Wilbur ore No. 1, run of mine.

Wilbur run of mine is a moderately fine grained crystalline magnetite, the gangue consisting for the most part of quartz, calcite, and chlorite, occurring in seams and stringers throughout the ore. Other gangue minerals present in smaller amounts are hornblende and muscovite. Both sulphur and phosphorus are low.

TABLE VI.

Mill Log of Test No. 1, Wilbur Ore No. 1, Run of Mine.

Time.	Total Load. Amperes.	Separator No. 1. Amperes.	Separator No. 2. Amperes.	Voltage.	Remarks.
8.10 a.m.	.....	.....	.....	.....	Start power motor.
8.15	.....	.....	.....	.....	Water on separators.
8.20	.....	.....	.....	.....	Water on ball mill.
8.20	.....	.....	.....	.....	Start crush ore.
8.30	.....	.....	.....	.....	
8.45	200	6·25	6·00	110	Samples taken.
9.00	200	6·25	6·00	110	"
9.15	205	6·25	6·00	109	"
9.30	200	6·00	5·75	109	"
9.45	210	6·00	5·75	109	"
10.00	195	6·00	5·75	109	"
10.15	195	6·00	5·75	108	"
10.30	200	6·00	5·75	111	"
10.45	200	5·75	5·50	111	"
11.00	210	5·75	5·50	110	"
11.15	205	5·75	5·50	109	"
11.30	205	5·75	5·50	110	"
11.45	205	5·75	5·50	110	"
12.00	205	5·75	5·50	108	"
12.15 p.m.	210	5·75	5·50	109	"
12.30	210	5·75	5·50	110	"
12.45	200	5·75	5·50	110	"
1.00	200	5·50	5·25	110	"
1.15	200	5·50	5·25	110	"
1.30	195	5·50	5·25	108	"
1.45	195	5·50	5·25	108	"
2.00	200	5·50	5·25	109	"
2.15	210	5·50	5·25	108	"
2.30	210	5·50	5·25	109	"
2.45	200	5·50	5·25	110	"
3.00	200	5·50	5·00	110	"
3.15	205	5·50	5·00	110	"
3.30	200	5·50	5·00	110	Last sample taken.
3.40	200	5·50	5·00	108	All ore fed to ball mill.
4.00	190	5·50	5·00	110	" " "
4.15	195	5·50	5·00	110	Water off ball mill.
4.20	195	5·50	5·00	110	" separators.
4.25	195	5·50	5·00	110	Stop power motor.

Mean total load in amperes while feeding ore ..... 202·41

Mean voltage while feeding ore ..... 109·37

$$\text{Total E. H. P.} = \frac{202{\cdot}41 \times 109{\cdot}37}{746} = 29{\cdot}67$$

Mean amperes on separator No. 1 ..... 5·71

Mean amperes on separator No. 2 ..... 5·40

Mean voltage on separators ..... 109·68

E. H. P. required to excite separators

$$= \frac{(5{\cdot}71 + 5{\cdot}40)\ 109{\cdot}68}{746} = 1{\cdot}63$$

E. H.P. required for Blake crusher, elevator, ball mill, sand pump, and driving separators = 29·67 − 1·63 = 28·04
Weight of crude ore tested 20,165 pounds = 9·00 tons gross.
Time feeding ore..... 7 hrs. 20 min.
Rate feeding ore..... 1·22 gross tons per hour.
Rate per day, 24 hours..... ....29·28 gross tons.
E. H. P. day per ton crude ore..... 1·01

[1]Water Consumption.

Ball mill meter end of test.....1113 cub. feet.
" " " start " ..... 664 "

Water used..... 449 cub. feet.
Total time feed water to ball mill, 7 hrs. 55 min.
Rate of feed per minute, 0·99 cub. feet or 6·18 imp. gals.
Rate of feed per gross ton of ore crushed, 48·68 cub. feet or 304·25 imp. gals.
Magnetic separators meter end of test.....20,192 cub. feet.
" " " start " .....17,112 "

Water used..... 3080 cub. feet.
Total time feed water to separators, 8 hrs. 5 min.
Rate of feed per minute, 6·35 cub. feet or 39·69 imp. gals.
Rate of feed per gross ton of ore crushed, 312·22 cub. feet or 1951·25 imp. gals.
Total water feed per minute, 7·34 cub. feet or 45·87 imp. gals.
Total water feed per gross ton of ore crushed, 460·9 cub. feet or 2256·0 imp. gals.

Crushing Data.

Crude ore broken in Blake crusher to 1″ and under, fed direct to ball mill.
Ball mill charge.....1549 lbs. 4″ hard iron balls.
" " " ..... 500 lbs. 3″ " " "

Total.....2049 lbs.

Mechanical condition of ball mill discharge.

					Per cent.
Through	20	on	30	mesh.....	0·068
"	30	"	40	"	0·273
"	40	"	50	"	1·847
"	50	"	60	"	2·224
"	60	"	70	"	5·029
"	70	"	80	"	1·659
"	80	"	90	"	9·512

[1]Note—One cub. foot of water taken = 6·25 imperial gallons.

	Per cent.
Through 90 on 100 mesh	3·722
" 100 " 120 "	7·801
" 120 " 150 "	14·063
" 150 " 200 "	20·804
" 200 " —	32·985
Total	99·987

TABLE VII.

Analyses of Crude, Concentrates, and Tailings.

——	Crude Ore.	Concentrates.	Tailings.
Iron	48·5	66·10	7·2
Insoluble residue	13·08	3·30	
Sulphur	0·105	0·028	
Phosphorus	0·011	0·004	
Lime	3·00	0·30	
Magnesia	6·40	1·40	

FROM THE ABOVE ANALYSES.

$$\text{The units of crude required for unit of concentrate} = \frac{66\cdot1 - 7\cdot2}{48\cdot5 - 7\cdot2} = 1\cdot43$$

$$\text{The percentage of iron in crude, saved in the concentrate} = \frac{10 \times 66\cdot1}{48\cdot5 \times 1\cdot43} = 95\cdot306$$

Units of tailings made per unit of concentrate = 0·43

$$\text{The percentage of iron in crude lost in the tailings} = \frac{100 \times 7\cdot2 \times 0\cdot43}{48\cdot5 \times 1\cdot43} = 4\cdot464$$

Gross tons of concentrate made per gross ton of crude, 0·699

TEST NO. 2, WILBUR ORE NO. 2, WASTE DUMP.

The ore for this test was taken from a waste dump at an old shaft, situated in a northerly direction from the present or main workings.

The physical structure of this ore is similar to the run of mine, the crystallization being moderately fine. Granitic gneiss forms the major part of the associated gangue; but calcite, and chlorite are also present in about the same proportion as in the run of mine.

TABLE VIII.

Mill Log of Test No. 2, Wilbur Ore No. 2, Waste Dump.

Time.	Total Load. Amperes.	Separator No. 1. Amperes.	Separator No. 2. Amperes.	Voltage.	Remarks.
8.30 a.m.	.....	.....	.....	.....	Start power motor.
8.35	.....	.....	.....	.....	Water on separator.
8.45	.....	.....	.....	.....	" ball mill.
8.50	.....	.....	.....	.....	Start crush ore.
9.00	200	6·25	6·00	109	"
9.15	220	6·25	6·00	110	Samples taken.
9.30	214	6·25	6·00	110	"
9.45	218	6·25	6·00	110	"
10.00	220	6·00	6·00	110	"
10.15	210	6·00	5·75	110	"
10.30	205	6·00	5·75	110	"
10.45	210	6·00	5·75	110	"
11.00	224	6·00	5·75	108	"
11.15	215	6·00	5·50	110	"
11.30	215	5·75	5·50	109	"
11.45	210	5·75	5·50	109	"
12.00	210	5·75	5·50	110	"
12.15 p.m.	210	5·75	5·50	110	"
12.30	215	5·75	5·50	110	"
12.45	200	5·75	5·50	110	"
1.00	215	5·75	5·50	110	"
1.15	220	5·75.	5·50	108	"
1.30	200	5·75	5·50	108	"
1.45	200	5·75	5·50	109	"
2.00	214	5·50	5·25	109	Last sample taken.
2.10	218	5·50	5·25	110	All ore fed to ball mill.
2.30	200	5·50	5·25	110	
2.45	195	5·50	5·25	110	Water off ball mill.
3.00	195	5·50	5·25	110	" separator.
3.15	195	5·50	5·25	109	Stop power motor.

Mean total load in amperes while feeding ore.....211·5

Mean voltage while feeding ore.....109·5

$$\text{Total E. H. P.} = \frac{211{\cdot}5 \times 109{\cdot}5}{746} = 31{\cdot}04$$

Mean amperes on separator No. 1..... 5·82

Mean amperes on separator No. 2..... 5·57

Mean voltage on separators.....109·53

$$\text{E.H.P. required to excite separators} = \frac{(5{\cdot}82 + 5{\cdot}57)\ 109{\cdot}53}{746} = 1{\cdot}67$$

E.H.P. required for Blake crusher, elevator, ball mill, sand pump, and driving separators = 31·04 − 1·67 = 29·37

Weight of crude ore tested, 11,777 pounds = 5·257 tons gross.

Time feeding ore..... 5 hrs. 20 min.

Rate feeding ore..... 0·985 gross tons per hour.

Rate per day 24 hours.....23·64 gross tons.

E.H.P. day, per ton crude..... 1·31

Water Consumption.

Ball mill metre end of test.....1479 cub. feet.
" " " start " .....1119 "

Water used..... 360 cub. feet.

Total time feed water to ball mill, 6 hrs. 0 min.
Rate of feed per minute, 1·00 cub. feet or 6·25 imp. gals.
Rate of feed per gross ton of ore crushed, 60·91 cub. feet or 380·68 imp. gals.

Magnetic separators meter end of test.....23,340 cub. feet.
" " " start " .....21,492 "

Water used..... 1848 cub. feet.

Total time feed water to separators, 6 hrs. 25 min.
Rate of feed per minute, 4·8 cub. feet or 30·0 imp. gals.
Rate of feed per gross ton of ore crushed, 292·3 cub. feet or 1826·8 imp. gals.
Total water feed per minute, 5·8 cub. feet or 36·25 imp. gals.
Total water feed per gross ton of ore crushed, 353·21 cub. feet or 2207·48 imp. gals.

Crushing Data.

Crude ore broken in Blake crusher to 1" and under, fed direct to ball mill.

Ball mill charge.....1549 lbs. 4" hard iron balls.
" " " ..... 500 lbs. 3" " " "

Total.....2049 lbs.

Mechanical condition of ball mill discharge.

					Per cent.
Through	10	on	20	mesh.....	0·126
"	20	"	30	"	0·202
"	30	"	40	"	1·530
"	40	"	50	"	4·751
"	50	"	60	"	4·091
"	60	"	70	"	7·227
"	70	"	80	"	1·819
"	80	"	90	"	7·025
"	90	"	100	"	5·025
"	100	"	120	"	6·115
"	120	"	150	"	8·718
"	150	"	200	"	16·880
"	200		——	.....	36·491
					100·000

TABLE IX.

Analyses of Crude, Concentrates, and Tailings.

	Crude Ore.	Concentrates.	Tailings.
Iron	38·2	64·6	5·
Insoluble Residue	22·18	6·11	
Sulphur	0·101	0·023	
Phosphorus	0·011	0·006	
Lime	3·20	0·14	
Magnesia	7·0	1·64	

From the above Analyses.

The units of crude required per unit of concentrate $= \frac{64\cdot6 - 5\cdot1}{38\cdot2 - 5\cdot1} = 1\cdot79$

The percentage of iron in crude, saved in the concentrate $= \frac{100 \times 64\cdot6}{38\cdot2 \times 1\cdot79} = 94\cdot485$

Units of tailings made per unit of concentrate $= 0\cdot79$

The percentage of iron in crude, lost in the tailings $= \frac{100 \times 5\cdot1 \times 0\cdot79}{38\cdot2 \times 1\cdot79} = 5\cdot892$

Gross tons of concentrates made per gross ton of crude $= 0\cdot558$.

GENERAL CONCLUSION.

As regards the purity of the concentrates and the percentages of iron recovered, the above tests clearly demonstrate the value of the Gröndal method of concentration as applied to the above class of inferior iron ores. The low phosphorus content of the concentrates renders them especially valuable for the manufacture of certain low phosphorus steels, and there is no doubt that if a sufficient tonnage of these concentrates can be produced, a profitable market would be found.

It is necessary to state, however, that these finely divided concentrates would require nodulizing or briquetting before they would be accepted for furnace use. This, of course, means an additional item of cost, but not as is generally supposed a prohibitive one.

The data given covering the mechanical operation of the plant during the tests is not satisfactory, the rate of ore fed per hour being very low, with a consequent high figure for electric horse-power per day, per ton of crude. This is in some measure due to the various unfavourable conditions that are always present

with the first operation of new and untried machinery. The chief difficulty, however, was lack of water. The plant being supplied from the Ottawa city mains, suffered from the inadequate supply occasioned by a season of almost unprecedented low water condition of the Ottawa river. The two magnetic separators require a normal supply of about 55 gallons of water per minute; and as the total available supply was from 20 to 25 per cent less than this amount, it meant less capacity in ore feed.

After the second test had been completed, the water pressure became so low that it was deemed advisable to cease operation until conditions were more favourable for testing at full capacity.

Tests on the remaining samples will be published in a later report.

All analyses for the tests made in Ottawa were made by H. A. Leverin, Ch. E.

FIELD WORK

PRELIMINARY REPORTS.

ON THE MOLYBDENUM ORES OF ONTARIO AND BRITISH COLUMBIA.

Dr. T. L. Walker.

During the field season of 1910, the writer was engaged in examining some of the Canadian deposits of molybdenite. In the previous year most of the molybdenite localities of importance in the Maritime Provinces and Quebec were visited, and a preliminary report submitted on the same. Most of the past season was employed in studying the chief deposits in Ontario and British Columbia; but in September, attention was directed to some deposits in New Brunswick and Quebec not previously visited.

New Brunswick.—For many years it has been known that molybdenite occurred in quartz veins cutting altered slate near the confluence of the Southwest Miramichi and Burnt Hill brook. An examination of the district shows that no development work has been done, and that the surface showings are not very promising for molybdenum. The veins are not large and the percentage of molybdenite is small. During this investigation the writer discovered that most of these veins carry tungsten in the form of wolframite—fairly large black crystals, and in such abundance as to hold out reasonable reward for development. Since this discovery some attempt is being made to open up some of the veins of wolframite.

Quebec.—The region visited lies about 20 miles south of the Transcontinental railway possibly 150 miles east of Cochrane. In the vicinity of Kewagama lake, especially on Indian peninsula, the country rock is largely granite, which is intersected by dykes of pegmatite, and veins of quartz. These frequently carry molybdenite and bismuthinite in promising proportions. The Height of Land Mining Company was the first to interest itself in this region, and some four years ago a shaft was sunk, and some drifting done. During the past year the St. Maurice Syndicate, and the Peninsular Mining Syndicate have taken up numerous claims on Indian peninsula, and during the past summer considerable development was undertaken.

Ontario.—Numerous deposits of molybdenite have long been known in the northeastern portion of Ontario—principally in the region which drains into the Ottawa river. Many of the previously well known deposits were visited, and some

new ones, which had been known only locally, were examined. It is particularly in the county of Renfrew that the most promising deposits occur. While none of the deposits are in operation, several are very promising, and well worth exploration. Samples, representing the type and grade of ore which might be obtained for milling and concentration from the various deposits, were collected for investigation.

British Columbia.—In this Province molybdenite has been reported from a large number of localities. Many of the most promising were visited, but some are almost inaccessible, and can be reached only at an expense altogether out of proportion to the object in view. Some of the deposits in this Province are associated with copper ores, as is the case on Texada island, Rossland, Highland valley near Ashcroft, and Grande Prairie near Kamloops. In the first two cases, the copper deposits have been worked, but so far as can be learned, no income was derived from the molybdenite content.

The details regarding the various deposits examined are being incorporated in a report on the "Molybdenum Ores of Canada," now in the press.

ON THE COPPER MINING INDUSTRY IN ONTARIO, 1910.

Alfred W. G. Wilson, Ph.D.

The first part of the field season of 1910 was spent in visiting the five principal districts in the Province of Ontario in which copper prospects had been reported.

North Hastings.—In the year 1903 copper pyrites was found to underlie iron ore on a prospect that had been opened up as a hematite mine, near Eldorado, on the Central Ontario railway.

As far as could be judged from the abandoned workings, the original hematite ore body, which outcropped at the surface, was a lenticular mass of ore about 175 feet in length, and probably 25 feet in width, at the widest part. The wall rock is a highly metamorphosed and partly altered rock; probably a hornblende-mica schist. The ore body was apparently a zone of rock, highly impregnated with, and partly replaced by, sulphides of iron and copper—the former predominating; subsequently, the upper portion was altered to hematite, the copper being leached out. The mining operations for iron ore disclosed the existence of scattered sulphides at depths which varied between 60 and 80 feet. Diamond drilling is said to have been employed to explore the sulphide portion of the ore body. A small water jacketed matting furnace, which was subsequently erected at the mine, was blown in first, June, 1906, and was operated intermittently for a year or more. Sinking in the ore body was continued until a depth of about 300 feet was reached. The mine was closed in 1907, and both mine and smelter have been idle ever since.

In this connexion, it appears desirable to repeat and emphasize what has already been stated in reports by E. J. Fraleck to the Ontario Bureau of Mines: that sulphides will probably be found in the localities where hematite has been mined in this district. In a number of instances mining operations are stated to have been stopped because the iron ore ran too high in sulphur. Mining was mostly in open-cuts, and was rarely carried below the 100 ft. level. There seem to be reasonable grounds for assuming that these hematite deposits were merely the altered upper portions of larger lenses of sulphides. Now that the market demand for pyrites ore makes it nearly as valuable as the iron ore for which the properties were first exploited, judicious and systematic prospecting might disclose valuable sulphide deposits beneath the old workings.

Parry Sound District.—In the year 1894, finds of copper pyrites were reported from a number of localities in the townships of McDougall, Cowper, and Foley—Parry Sound being the nearest town. On one of these properties—the McGowan mine, lot 146, con. IV, Foley, about 2 miles east of Parry Sound, a small pocket of rich ore, chalcopyrite, and bornite, was found. Smaller bodies of sulphides were found subsequently in several other places. A very considerable amount of exploration appears to have taken place, but no ore in commercial quantities is reported. A visit to several of the principal localities showed only abandoned workings.[1]

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[1] See Coleman, Ontario Bureau of Mines Report, Vol. VIII, 1898, pp. 259-262.

Sudbury District.—Copper is one of the most important constituents of the nickeliferous pyrrhotites of the Sudbury district. Detailed investigations of this district have been made both by the Federal Department of Mines and by the Ontario Bureau of Mines. In the annual reports of the Inspector of Mines for Ontario reference is always made to the condition of the mines, to the amount of development work, and to any new discoveries of importance. I spent about ten days in the district, visiting the principal mines and smelting works, for the purpose of becoming personally acquainted with the local conditions. The mining development and prospecting work which has been going on in this district for a number of years, and which has been vigorously pushed during the last two or three years, was being continued and extended. For 1910 the annual output of the copper mines of Ontario—nearly all of which comes from this district—is placed at 19,259,016 pounds by the Division of Mineral Resources and Statistics of the Mines Branch.

North Shore of Lake Huron.—Along the north shore of Lake Huron, westward from the pyrrhotitiferous norites of the Sudbury district, and extending north of the lake for at least 40 miles, is an area largely underlain by basic metamorphic rocks which has been invaded by acid and basic intrusives. Quartz veins, sometimes of considerable width and lineal extent, are found in numerous localities throughout the area. Many of these quartz veins contain small flakes and masses of chalcopyrite, occasionally of considerable size. The number of recorded claims is large, prospecting has been carried on in many localities, and in some few instances extensive development work has succeeded prospecting. Some of the earliest discoveries of copper ores in Ontario were in this district: at the old Wallace mine—now long since abandoned—and at the well known Bruce mines. The varied history of these mines has been described in reports of the Ontario Bureau of Mines, and in papers presented to several mining associations.

At the present time the only property in operation is the Bruce mines, from which about fifty tons of ore per day are being hoisted. This ore, which consists of chalcopyrite in almost pure quartz, is being used at the smelter of the Mond Nickel Company, at Victoria mines, for lining the converters.

Extensive underground exploration, and some development work has been done on three other properties in the district: viz., the Superior, the Hermina, and the Massey mines. Prospecting work has also been carried on at a number of other properties, but none of them have been operated for any great length of time. Ore shipments were made continuously, for a few years, from each of the three larger properties mentioned above. At the time of my visit to the locality in July, no work was being done at the Superior mine, and the Hermina had just closed down. At the Massey mine preparations are in progress for further explorations by the Vermilion River Copper Company.

The ores which come from the district are all highly siliceous; and with the exception of that from the Bruce mine, there is a large quantity of basic rock material mixed with the ore. This has reduced the silica content, and lowered the value for use in the smelting operations at Victoria Mines and at Copper Cliff.

It should also be noted that, the company controlling the Hermina mine erected a small reverberatory furnace, fired with producer gas, in an attempt to produce matte directly from the Hermina ores. This plant, which is located at Thessalon, is now idle.

It has long been known that occurrences of copper minerals are widespread in this district. Many prospects have been discovered which contain low grade ores. They have rarely been sufficiently explored to demonstrate their extent. The difficulty of recovering the copper content economically has not yet been surmounted. Without some adequate method of concentration, it has not been possible to exploit the prospects for any length of time in any locality. Nearly all the companies which have operated in the district have at some time or other erected concentrating plants, but no method has yet been employed which has been operated more than a short period. The hard quartz gangue, associated with the relatively soft and friable chalcopyrite, renders it very difficult to crush the ore without producing an undue quantity of fines; while the losses in concentration are unusually high.

Keweenawan Areas.—Amygdaloidal diabases carrying native copper—very similar to the deposits of the famous Keweenaw peninsula in Michigan—occur on the east shore of Lake Superior, between Batchawana bay and Point aux Mines, at Michipicoten island; and on the north shore on several islands in Nipigon bay, especially St. Ignace island. Native copper has been found at many places, both in veins and in the amygdaloidal portions of the trap sheets. Mining claims were first taken up on the areas about 1847. At several points extensive operations were carried on for a number of years, but, probably, never at a profit. At the present time all the properties are idle.

In the years 1906-8, the Calumet and Hecla Mining Company put down drill holes on a line running northeast from near Sand Bay, crossing portions of the Pancake Point and Sand Bay locations, on the east shore of Lake Superior. No important copper bearing beds were disclosed in this set of holes. The drill cores were afterwards examined in detail by Dr. Alfred C. Lane—at that time State Geologist of Michigan—and a brief geological study was made of these two localities.

In a memorandum which Dr. Lane has kindly supplied to me, he states that:—

> "The rocks and associated prehnite, epidote, and other secondary minerals are like those at Keweenaw peninsula. The trap flows have amygdaloidal tops, and the upper or south-western beds, like the central beds of Keweenaw point, are largely ophites, with mottles in one case over half an inch across. They dip towards the lake 23° and more, and veer in strike from N. 45° W. to N. 10° W. They are cut by numerous faults, the most prominent set of which run nearly north and dip 45° to the east. Thus troughs or shoots are produced which pitch to the south. Native copper is, I think, more common in the bedded lodes. Both native copper and sulphides (chalcocite mainly) occur in the fissures in and near which most of the concentration seemed to occur. Felsites are also abundant, in part at least intrusive, and drilling by the Calumet and Hecla disclosed the same (with pyrites not found to carry values along the contents) in drift-covered areas. With these and faults to make explorations expensive, nothing was found nearly as attractive as in places in Michigan, though the upper 2,000 feet of beds were cut. Yet the work has been confined practically to the upper part of the formation and the shoots above mentioned will no doubt be further investigated by some one."

It may be added that arrangements have been made, with the consent of the manager of the Calumet and Hecla Mining Company, for Dr. Lane to contribute a chapter on these Keweenawan copper-bearing amygdaloids to the report on the copper resources of Canada, which is now in course of preparation.

A small amount of diamond drilling was done at Cape Gargantua in 1909, but no satisfactory results appear to have been obtained.

During the past summer the British North American Mining Company were carrying on exploration work at the old Prince location, on the north shore of Lake Superior, and at Spar island. The annual report to the shareholders indicates that, in drifting they have encountered both native copper and native silver. It is intended to continue the exploration work during the winter.

During the early part of 1910 a number of buildings were erected and a good deal of costeaning was done on the north side of Michipicoten island on and near the old Bonner location. Small pieces of native copper and a few large pieces were recovered by washing the beach gravels at certain points on this shore. No discoveries of importance were made. It may be noted that at this point there are several superposed trap sheets with amygdaloidal upper portions. The amygdales are either pink or white coloured minerals, and where the beds are washed by the waves the amygdaloidal portions of the trap beds are clearly distinguishable because of their prevailing light colour. In the same locality there are a few narrow veins, rarely lying parallel to the bedding structure. These amygdaloidal beds have erroneously been called veins. Had the nature of these beds, with which the native copper seems to be associated, been recognized, and their definite relation to the other portion of the individual trap sheets—with which each is associated—been determined, much needless expenditure for excavation across, what under all normal conditions are barren portions of the trap sheets, would have been avoided.

While it may be stated that these Keweenawan rocks afford ample opportunity for careful and systematic exploration, with reasonable expectations of discovering low grade native copper ores in economic quantities, fuller discussion must be reserved for the final report.

Other Localities.—Copper ores have been reported from a number of other localities, along the north shore of Lake Superior, west of Port Arthur, and in, or adjacent to, the Timagami Forest Reserve. No important mines have been developed, in only a few instances have any mining operations been carried on, and, in the majority of cases, their distance from established lines of transportation would practically prohibit mining operations unless a deposit of very large size was discovered. No attempt was made to visit any of the outlying prospects, though in future years some of them may prove to be of importance.

Conclusion.—In concluding the portion of this summary report relating to Ontario, I wish to state that there are three areas in Ontario of which detailed geological surveys should be made, and maps prepared. These districts are:—

(1) Central Ontario embracing the northern portion of the county of Hastings and some areas to the east.[1]

(2) North shore of Lake Huron between the Sudbury district and Lake Superior.

(3) Keweenawan areas as a whole.

Such studies and maps are now universally recognized as a primary prerequisite to systematic and intelligent economic exploration.

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[1] The southeast corner of the district is covered by Geological Survey Maps Nos. 708 and 770.

SESSIONAL PAPER No. 26a

THE COPPER MINING INDUSTRY IN THE MARITIME PROVINCES, 1910.

At the present time there are no copper producing properties in the Maritime Provinces. Copper minerals have been found in many localities. During the last fifty years prospecting, and some development work have been done in a number of places, and shipments of small quantities of rich ores have been made at irregular intervals, from some of these localities. Some of the properties have more than once been closed down and re-opened.

The majority of occurrences of copper minerals which have been reported in the Provinces of New Brunswick and Nova Scotia are already recorded in a report by Dr. R. W. Ells.[1] Many of these were, probably, never of sufficient magnitude to warrant any extensive exploration. Many years ago, others were prospected for a time, but no reliable record as to the results of this exploration can now be obtained. The fact that they were not operated for any length of time is generally taken as an indication that the results obtained were not very satisfactory. A few properties gave promise of containing ore in economic quantities, and were operated for a time, and small quantities of commercial ore were obtained. Various difficulties appear to have arisen, because, after operating for periods of time, varying in different cases, the work was stopped. In some instances this cessation was caused by financial difficulties, and closure took place before it had been demonstrated whether ore was present in commercial quantities. In others, work was stopped because the ore played out.

In all the districts visited, both in New Brunswick and in Nova Scotia, there is an overburden of loose soil which makes it difficult to draw any conclusions from surface conditions. The individual rock outcrops are usually small, and the sulphide deposits, if they exist in quantity in any locality, would be very apt to be found, not at the outcrops, but in the soil covered hollows adjacent to them. This makes surface prospecting difficult, and underground exploration is usually necessary to prove even the smallest deposits.

New Brunswick.—Up to the present time, I have not found in New Brunswick, any properties which have been proved to contain copper ores in commercial quantities. There are, however, several localities in which recently made discoveries warrant further search, in the expectation of finding pay ore.

Near Scotch Settlement siding, on the New Brunswick Coal and Railway Company's line, 11 miles north of Norton, a deposit of chalcopyrite and pyrite was discovered some time ago. The property, which is under control of G. W. Ganong, St. Stephen, N.B., was being prospected during the past summer, by means of trenching and a trial shaft. The metallic sulphides are found associated with chlorite schist and quartz. The prospecting work had disclosed a showing of good ore, at the time of my visit; but much further work will be necessary to ascertain if ore occurs in the locality in commercial quantities.

Another property which may contain commercial ore is the old Freeze mine in the township of Ireland, about 8 miles south of Elgin. The old mine workings lie in a valley close beside a branch of the Salmon river. No rock outcrops are visible immediately in the vicinity of the mine, and further exploration work will

[1] Bulletin on the ores of copper in the Provinces of Nova Scotia, New Brunswick, and Quebec, Geol. Surv. Can., 1904.

have to be done, either by drilling, or by sinking and drifting. The present shaft is said to be 163 feet in depth, and there is some drifting. A small water-jacketed matting furnace was operated on this property for a short time. The ore is chalcopyrite and pyrite, in a schist which consists chiefly of hydro-mica and quartz. The ore resembles that found in the King and Suffield mines in Quebec.

At a prospect known as the Lumsden property, situated on Ratty Brook branch of Crooked creek, in Albert county, a considerable amount of surface and underground prospecting has been done. Samples of ore found on the property are said to contain values in gold and silver, in addition to lead and copper.

During parts of the years 1908 and 1909 the old Vernon mine near Martins Head, on the Bay of Fundy, was reopened, and operated on a small scale. About 50 tons of ore—a portion of which was rich bornite—were mined and shipped. The greater portion of the work was of an exploratory nature. This work is said to have disclosed a vein carrying rich bornite ore. No work was carried on there during the past season.

Copper minerals have been reported from a number of other localities in southern New Brunswick, and in some other cases a limited amount of prospecting work has been done. Some of these localities are doubtless worthy of further exploration. On none of them—as far as I have been able to learn—has there been sufficient development to show commercial ore in quantity. In the circumstances, it was felt that no useful purpose would be served by spending time in making further personal inspection of undeveloped prospects.

Copper ore in the form of chalcocite occurs associated with carbonaceous fossils in the sandstones of the upper Carboniferous formation at many points along the south side of Northumberland strait and westward in Albert county in New Brunswick. During the past sixty years numerous attempts have been made to work these ores profitably, and in some few cases small shipments of rich natural concentrates have been made. In no place, however, have these ores ever been discovered in sufficient quantity to make their exploitation, for any length of time, a profitable venture. During the month of December, 1909, and the early months of 1910, two drill holes were put down in a search for ores of this character on a property just south of the old Intercolonial Copper Company's property, about 4 miles from Dorchester, New Brunswick. The results obtained by this work are not available. At the time of my visit in October, work had ceased, and the drill had been removed.

Nova Scotia.—Localities in which copper ores occur in Nova Scotia, that are worthy of special note, are: Cape d'Or; Copper lake; Cheticamp; and Coxheath.

At Cape d'Or, in Cumberland county, on the north side of Minas channel, native copper has been found associated with some diabase sheets. With reference to this locality, Dr. A. C. Lane, who has studied the district in some detail, and who had at his disposal the results of the drilling operations carried on by the Colonial Copper Company some years ago, has supplied the following memorandum in which he draws a comparison between the Cape d'Or locality and the Keweenawan of Michigan.

"The Cape d'Or locality has many points of likeness to the Keweenawan district of Lake Superior, though the trap sheets were formed at the beginning of the Mesozoic instead of the beginning of the Palæozoic. In both the beds are old basalt flows which dip towards the water, but at Cape d'Or the dips are lower, lying between 10° and 25°. In both the beds are cut by nearly vertical faults, many of which run about south, in both native copper is the most abundant ore, and it occurs in fissures and throughout shattered belts of rock along the faults more than with amygdales, so far as could be ascertained.

"The associated minerals are different, stilbite, heulandite, and analcite being abundant at Cape d'Or. The drilling and shafts of the Colonial Copper Company seem to show five lava flows (135, 58, 32, 10 to 15+, and 556 feet thick respectively)—the uppermost being more markedly porphyritic. The intermediate flows are thinner and where these were crossed and shattered by fissures some areas of stoping rock were found. These shoots are cut off by the ocean which has done some concentration on its own account. The lowest trap exposed, the Cape Spencer trap, is apparently about 600 feet thick making about 800 feet in all. The chemical analyses you have had made show this to be a bandose, while the uppermost bed is also akin to the enstatite diabases and belongs to class 3, subclass 1, order, rang and subrang 4, and may be called a dorose. Beneath this come sediments, but no mining has shown what concentration of copper may occur just below this heavy Cape Spencer trap, which—judging from Lake Superior and New Jersey experience—would be desirable. The amount of copper which can be picked up along the beach at Cape d'Or is due largely to the marine erosion attacking some amygdaloids which are dipping towards the ocean. Whether these amygdaloids, if struck somewhere deep down under the Bay of Fundy, would be found to have copper in abundance, and whether the contact of the series of traps with the red gypsiferons Triassic beds beneath shown in one hole would show copper, are questions which the explorations so far conducted have not answered."

At Copper Lake mine, in Antigonish county, about 17 miles from Antigonish and 16 miles from Country harbour, the Copper Lake Mining Company have been prospecting for several years. Two shafts, 180, and 290 feet, respectively, have been sunk on the property, the deeper shaft being inclined and located on the ore body. An adit has been driven to the first level. The total length of the ore body exposed along this level is about 350 feet. On the second level, about 50 feet of drifting has been done. A number of exploratory cross-cuts have also been driven into the hanging and foot walls.

The ore body is a most interesting one. The gangue consists almost wholly of siderite. A clean piece, purposely selected free from sulphides, gave the following analysis:—[1]

SiO_2	0·65
FeO	45·77
Fe_2O_3	0·53
Al_2O_3	0·20
CuO	trace
MnO	trace
CaO	0·61
MgO	10·80
CO_2	40·20
H_2O	0·80
P	0·004
S	0·040

The ore body, as disclosed by the development work, appears to be a portion of a vein located in a fracture zone. The upper part of the vein has been removed by erosion. At the east end of the ore body which has been explored, the vein narrows and finally breaks into a number of smaller veins. The west end has not

[1] Mr. H. A. Leverin, analyst.

been explored beyond the adit, as the vein at, and near the surface, has been eroded, and possibly passes beneath Copper lake. The Copper Lake Company is now contemplating the work of following the vein in this direction beneath the lake. The ore body also narrows at depth; the maximum width of the ore body is stated to be 11 feet in the shaft above the second level. The average width of the ore body on the first level is about 5 feet. Development work has not yet disclosed whether the ore body is an isolated lenticular mass of ore, or whether it is a portion of a much larger vein which has been constricted at certain points. The discovery of float vein material in the adjacent fields, and the nature of the locus of the portion of the vein already developed make it quite reasonable to expect that the vein has a much greater lateral extent than is now known. Further systematic exploration will be required to determine this extension with certainty.

The metallic sulphides present are chiefly pyrite and chalcopyrite, with a small amount of pyrrhotite in places. The pyrrhotite is reported to carry low nickel values. It is stated that the copper content of the ore body, so far exposed by development work, will exceed 3 per cent metallic copper.

The Lake Copper Company is also interested in some copper prospects about 2 miles west of Lochaber lake in Antigonish county. The first prospecting shaft on this property was sunk about 35 years ago. Since that time additional trial pits and shafts have been put down. On the bases of old reports officers of the Company regard these prospects with favour, and are planning to re-open them for further exploration. Little information can be obtained from the surface showings as to the probable occurrence of copper ore.

Copper minerals have been found at a number of other localities in Antigonish county and prospecting work has been carried on from time to time. The majority of these mineral occurrences have already been noted in reports by officers of the Geological Survey Branch. No occurrences of commercial quantities of ore have been found except at Copper Lake.

According to Fletcher[1] prospecting for copper ores was carried on at Cheticamp, in Cape Breton, prior to 1864. Since that date the prospects have been re-opened at several different periods. The properties are at present controlled by the Cheticamp Copper Company, Limited, which was incorporated in 1904 to take over the interests of several independent companies which controlled properties on and adjacent to the Cheticamp river in Inverness county. This Company and its immediate predecessors have performed extensive development work on the prospects, and the present Company has also built a good road which connects the property with Eastern harbour. Operations were discontinued in 1906 and the plant and buildings have been allowed to depreciate. The Company has in its possession a number of very favourable reports on its property, but it has never carried its development work to the shipping stage except for experimental purposes.

The Cheticamp ore is chalcopyrite impregnating a mass of sericitic and chloritic schists. It also carries low values in gold and silver. The reports of those who have examined the property would indicate that, there is a very large body

[1] G. S. C. Report 1882-84, p. 95, H.

of low-grade copper ore present. The practical problem which has not yet been solved is the development and application of a process of extracting the copper from these ores, at a profit. The finely disseminated character of the ore, and the nature of the rock in which it occurs, make this a very difficult problem.

More than thirty years ago the occurrence of metallic sulphides, associated with a felsitic rock, was noted at Coxheath, about 10 miles from Sydney, C.B. The first exploration work was performed on the prospects in 1880. During the next twelve years, a number of shafts were sunk, and extensive explorations were carried on, underground. Since 1892, no work has been done on the property. It is stated that there is a considerable quantity of developed ore available in the mine. The expenditure on development work has been very large, but as yet no commercial shipments have been made.

Copper minerals have been reported from a number of other localities in Nova Scotia. Native copper has also been found in the western part of the Province, associated with the trap sheets of North mountain. Much prospecting has been done on a small scale at many points, but as far as could be learned, no important ore bodies have been discovered. A more extended reference will be made in the final report to a number of these prospects; and especially to the occurrences of chalcocite associated with carbonaceous material in the sandstones along the southern shore of the straits of Northumberland.

THE AUSTIN BROOK IRON-BEARING DISTRICT, NEW BRUNSWICK.

E. Lindeman, M.E.

The first part of the field season of 1910 was spent in the Austin Brook iron-bearing district, New Brunswick; with the object of extending the magnetic survey commenced by the writer in the fall of 1906, but suspended during the following years. During the summer a magnetometric and topographical survey was made of an area comprising about 1·5 square miles. W. M. Morrison, B.Sc., acted as assistant, and performed his duties in a highly satisfactory manner. For the many courtesies received during the field work the writer is indebted to Mr. Fulton, local superintendent of the Canada Iron Corporation, Limited

Location and Topography.—The iron ore deposits are situated in the county of Gloucester about 20 miles south, southwest of the town of Bathurst, in the vicinity of Austin brook—a small tributary of the Nipisiguit river.

The elevation of the district is about 350 to 500 feet above sea-level. Its main topographical feature is the Nipisiguit valley, with generally steep banks, rising to a height of 100 to 140 feet above the river. Back from the river the country becomes comparatively flat, with a few occasionally outstanding small hills, generally having a north and southerly trend. The district is thickly wooded with spruce, cedar, balsam, poplar, birch, and maple. Owing to the covering of glacial drift, and a number of swamps—which occupy a large part of the area—few exposures of ore can be seen. Any estimate of the size or general attitude of the ore bodies must, therefore, largely depend on the evidence furnished by a few diamond drill holes, and on the magnetometric survey.

History.—The first discovery of ore was made in 1897, by Mr. Wm. Hussey of Bathurst. In 1902, this gentleman, together with Mr. T. Burns of Bathurst, secured "Rights to search" upon several 5 mile locations in the district. During 1903, a representative of the Dominion Iron and Steel Company visited the locality, and some trenching and test-pitting was done. In the fall of 1906—at the request of O. Turgeon, M.P.—the writer was instructed to make a magnetometric survey of the district. The result of this investigation showed the field to contain a number of magnetic iron ore bodies, some of which were of large extent. In order to fully ascertain the quality of these bodies, the Provincial Government of New Brunswick was petitioned for the use of the diamond drill of the Province. The petition was granted, and during the year 1907 seven drill holes were put down. The records of five of these holes are given in the following pages. In November of 1907, the property passed into the control of the Canada Iron Corporation, Limited. A standard gauge railway 16 miles long has been constructed by this Company, connecting the property with the Intercolonial railway at Blacks Cut, about 4 miles south of the station of Bathurst. Ore docks for the trans-shipment of the ore have also been completed at Newcastle, with a storage capacity of 10,000 tons, and with a loading capacity of 3,000 tons per hour.

SUMMARY OF LITERATURE ON THE SUBJECT.

Ells, R. W.—

Report on the geology of Northern New Brunswick, embracing portions of the counties of Restigouche, Gloucester, and Northumberland. In Report of Progress for 1879-80 of the Geological and Natural History of Canada, pp. 1 D-47 D.

Lindeman, E.—

Magnetometric survey of iron ore deposits at Austin Brook, Gloucester county, N.B. In the annual report of the Superintendent of Mines, Department of Interior, Ottawa, for 1907, pp. 33-37.

Hardman, J. E.—

A new iron ore field in the Province of New Brunswick. In the Journal of the "Canadian Mining Institute," Vol. XI, 1908, pp. 156-164.

Young, G. A.—

Bathurst district of New Brunswick. In the Summary Report of the Geological Survey Branch of the Department of Mines, Ottawa, for 1909, pp. 217-224.

GENERAL GEOLOGY.

The greater part of the area under consideration is underlain by quartz porphyry, generally of schistose structure, owing to the intense folding and shearing to which it has been subjected. Its general strike is about north and south, with a steep dip towards the west. Associated with the porphyry are bands of chloritic and sericitic schists, which may be merely alteration phases of the porphyry. Generally, the porphyry shows distinct phenocrysts of feldspar and quartz, in a dense grey matrix.

In the southern and western part of the area eruptive rocks of basic character are found intruding into the porphyry. These rocks have been classed as gabbro diorites in the field; but their exact petrographical nature is not known, at present. They are usually of a greenish grey colour, and have a granitoid or granular structure. Other intrusions in the porphyry are numerous quartz veins. These are also very common in the ore but are rarely seen in the gabbro. They vary in size from a fraction of an inch, up to several inches in width.

Sedimentary rocks consisting of black and grey slates, highly tilted, and conformable to the porphyry, outcrop on the banks of the Nipisiguit river at Great falls, about 1½ miles below the mouth of Austin brook, but have, so far, not been observed within the area under consideration. Similar rocks are also exposed about one mile above Austin brook, and farther up the Nipisiguit river, at the Narrows, fragments of black slates were seen embedded in the porphyry. The porphyry seems, therefore, to be intrusive in this slate formation, the geological age of which is early Palaeozoic, probably Ordovician.[1]

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[1] See Summary Report of the Geological Survey for 1909, pp. 218.

Ore Deposits.—As far as present knowledge goes, the ore occurs as elongated lenses in the quartz porphyry, and shows in common with this a prominent parting or schistosity, the plane of schistosity being parallel to that of the country rock. The ore bodies lie in three main groups, which for reference have been numbered I, II, and III.

Group I is situated west of Austin brook, and consists of one ore body: the total length of which is about 2,000 feet. The northern end of this deposit is well exposed, rising abruptly to a height of 75 feet above Austin brook. Farther south, it is covered by gravel of considerable depth, but outcrops again about 100 feet from the Nipisiguit river, where its contact with the schistose porphyry is well exposed. The horizontal width of the ore body is, where drill hole No. 1 was sunk, 106 feet. This hole was put down vertically on the hanging wall, about 250 feet south of the northern end of the deposit. It struck the ore body at a depth of 35 feet, and continued in the iron-bearing formation to 162 feet, when the foot-wall was reached, giving a calculated thickness to the ore body of about 85 feet. Drill hole No. 2 was sunk vertically, about 700 feet south of No. 1. After going through gravel, etc., it struck the ore body at a depth of 49 feet, and reached the foot-wall at 162 feet, giving a calculated thickness to the iron-bearing formation of about 60 feet. Drill hole No. 3 was located on the hanging wall of the deposit, about 150 feet from Nipisiguit river, and drilled vertically to a depth of 49 feet, giving a calculated width to the iron-bearing formation of about 8 feet. Drill hole No. 4 was sunk 380 feet west of No. 2, at an angle of 70°, the bearing of the hole being S. 80° E.

The total depth attained by the hole was 527 feet. It struck the iron-bearing formation at a depth of 434 feet, and continued in it to 514 feet, when the foot-wall was reached, giving a calculated thickness to the iron-bearing formation of about 64 feet.

Group II lies east of Austin brook, and is made up of several ore lenses, which for reference have been numbered 1, 2, 3, and 4.

No. 1 deposit outcrops on the hillslope towards the Nipisiguit river, but is, according to the magnetic survey, of inconsiderable extent. No. 2 deposit outcrops on the eastern bank of Austin brook. The southern end of the deposit is well exposed, showing a width of 42 feet, with well defined walls. Farther north the deposit is covered by gravel, and few outcrops are available, but judging from the magnetic survey, we may assume the length of the deposit to be about 250 feet. At the north end its width is about 19 feet. No. 3 deposit lies in a gully about 180 feet north of No. 2, and is completely concealed by humus, except along the east bank, where its contact with the porphyry is exposed, in a few places. The total length of the ore body is estimated at about 350 feet. No. 4 deposit is located east of No. 3. It has a length of about 400 feet. At the southern end of the deposit the width was proved by stripping to be 30 feet, but is decreasing towards the north.

North of groups I and II, there is no indication of iron ore for a distance of about 1,600 feet, then, group III is encountered. This is for the most part covered by swamp, and it is only at its southern end that a few outcrops of ore can be seen. According to the result of the magnetometric survey, this iron-bearing area extends in a northerly direction for about 4,400 feet. It does not, however, consist of one

continuous ore body, but is made up of a great number of ore lenses, which vary considerably in size. On the main deposit, which lies in the southern half of the area, drill holes No. 5 and No. 6 have been sunk vertically. In No. 5, ore was encountered at a depth of 23 feet, and the core was continuously in ore to 347 feet. Drill hole No. 6 was sunk to a depth of 276 feet, showing, however, very lean ore, thickly streaked with jasper. The average width of the deposit at the surface is about 100 feet, and its total length according to the magnetometric survey may approximately be estimated at about 830 feet. About 150 feet north of this deposit another ore lens is situated, on which drill hole No. 7 was sunk. This ore body has a total length of about 400 feet, with a maximum width at the surface of about 90 feet. Besides these two ore bodies the magnetometric survey indicates the presence of a number of others which are all covered by humus, and on which no diamond drilling, so far, has been done.

Character of Ore.—The ore of the district consists of a very fine-grained, siliceous magnetite, mixed with a considerable amount of hematite. It is often found interbanded with jasper and a green slaty gangue material, which gives the deposits a conspicuous bedded structure. Veins of quartz are also, as already mentioned, of common occurrence, and generally follow the bedding planes of the ore. The metallic iron content of the various layers varies, therefore, considerably, ranging from 59 down to 35 per cent: the average being about 43 to 47 per cent.

The average phosphorus content is about 0·8 per cent, with the sulphur ranging from 0·03 to 0·1 per cent. Locally, however, the sulphur content is much higher. This is especially the case near the contact of the ore with the country rock, where layers of iron pyrites, varying in thickness from a fraction of an inch up to several feet, often occur.

The following tables give a number of analyses representing average samples taken by the writer:—

TABLE No. 1.

No. of Sample.	Metallic Iron %	Insoluble %	Phosphorus %	Sulphur %	Manganese %	Notes.
1.	43·7	26·3	0·64	0·05	1·00	Average sample from deposit No. 1 about 230 feet south of its northerly end.
2.	42·5	34·6	1·20	0·03	Not determined.	Average sample from deposit No. 1 about 100 feet north of Nipisiguit river.
3.	46·0	21·6	1·21	0·05	Not determined.	Average sample from deposit No. 1.
4.	46·6	24·7	1·04	0·02	1·8	Average sample from the southerly end of deposit No. 2.
5.	43·4	25·2	0·82	0·02	.....	Average sample from the northerly end of deposit No. 2.
6.	43·6	33·1	0·40	0·007	0·5	Average sample from deposit No. 4.
7.	44·5	28·5	0·83	0·03	.....	Average sample from group III.
8.	47·5	22·7	0·65	0·05	1·2	Average sample from group III.

Table 2 gives the records of four drill holes. The cores were shipped to the laboratory of the Mines Branch, at Ottawa, and analysed there by Mr. H. A. Leverin. With few exceptions, the average length of core represented by each analysis is 10 feet. The core of hole No. 7 was analysed at the laboratory of the Canada Iron Corporation, and the results, kindly placed at the disposal of the writer by Mr. Fulton, are given in Table 3.

TABLE No. 2.

Designation of Drill Hole.	Direction of Drill Hole.	Angle of Drill Hole.	Depth.	Analysis.					Remarks.
				Iron. %	Insoluble. %	Phosphorus. %	Sulphur. %	Manganese %	
			Feet						
Drill hole No. 1.	.....	90°	0 - 35′	.....	.....	.....	.....	.....	Hanging wall, porphyry and schist.
			35′- 40′	48·0	17·5	0·95	0·11	.....	Iron formation.
			40′- 50′	50·5	15·5	1·01	0·10	.....	
			50′- 60′	45·6	21·2	0·87	0·07	.....	
			60′- 70′	45·5	18·4	0·69	0·43	.....	
			70′- 80′	50·9	16·2	0·49	0·09	.....	
			80′- 90′	51·6	8·0	0·86	0·70	.....	
			90′-100′	39·6	24·7	0·85	0·10	.....	
			100′-110′	51·6	12·3	0·79	0·05	.....	
			110′-120′	44·5	20·9	0·75	0·08	.....	
			120′-130′	41·3	27·7	0·57	0·13	.....	
			130′-140′	53·9	12·6	0·74	0·65	.....	
			140′-150′	57·2	11·9	0·87	0·69	.....	
			150′-160′	49·8	16·6	0·94	0·78	.....	
			160′-162′	55·7	8·4	0·76	1·30	.....	
			162′-192′	.....	.....	.....	.....	.....	Footwall, porphyry and schist.
Drill hole No. 2.	.....	90°	0 - 49′	.....	.....	.....	.....	.....	Gravel, etc.
			49′- 50′	49·9	25·6	0·74	0·03	.....	Iron formation.
			50′- 60′	58·1	17·1	0·55	0·15	.....	
			60′- 70′	58·7	13·3	0·70	0·03	.....	
			70′- 72′	49·7	23·6	0·91	0·17	.....	
			72′- 82′	.....	.....	.....	.....	.....	Schist.
			82′- 90′	44·5	12·4	0·83	0·27	.....	Iron formation
			90′-100′	51·7	19·0	0·60	0·27	.....	
			100′-110′	50·1	19·6	0·88	0·04	.....	
			110′-120′	48·3	16·0	0·72	0·19	.....	
			120′-130′	50·1	16·4	0·71	0·10	.....	
			130′-140′	52·0	14·6	0·97	0·58	.....	
			140′-150′	45·1	10·1	1·08	18·21	.....	
			150′-160′	35·0	15·2	0·53	32·97	.....	
			160′-162′	44·1	6·9	0·50	37·08	.....	
			162′-172′	.....	.....	.....	.....	.....	Footwall, porphyry and schist.
Drill hole No. 4.	S. 80° E.	70°	0-8′	.....	.....	.....	.....	.....	Gravel.
			8′-434′						Hanging wall, gabbro, porphyry, and quartz.
			434′-444′	44·2	28·0	0·38	0·04	.....	Iron formation.
			444′-454′	42·5	24·0	0·73	0·09	.....	
			454′-464′	48·5	17·3	0·98	0·05	.....	
			464′-474′	45·4	16·1	1·00	0·06	.....	
			474′-484′	46·7	16·2	1·08	0·08	.....	
			484′-494′	50·8	14·8	0·87	0·15	.....	
			494′-504′	50·1	15·3	1·13	0·75	.....	
			504′-514′	.....	.....	.....	19·4	.....	
			514′-527′	.....	.....	.....	10·8	.....	Footwall,porphyry.

TABLE NO. 2. (*Continued.*)

Designation of Drill Hole.	Direction of Drill Hole.	Angle of Drill Hole.	Depth.	Analysis.					Remarks.
				Iron. %	Insoluble. %	Phosphorus. %	Sulphur. %	Manganese %	
Drill hole No. 5.	.....	90°	Feet 0 - 23′	.....	.....	.....	.....	.....	Peat and gravel.
			23′- 32′	50·5	17·8	0·90	0·09	.....	Iron formation.
			32′- 42′	52·2	10·7	1·61	0·03	.....	
			42′- 52′	52·1	13·8	1·03	0·04	.....	
			52′- 62′	52·8	14·1	0·52	0·04	.....	
			62′- 72′	55·8	10·5	0·90	0·04	.....	
			72′- 82′	48·8	18·0	1·04	0·06	.....	
			82′- 92′	50·2	18·0	0·96	0·06	.....	
			92′-102′	41·7	22·5	0·37	0·04	.....	
			102′-112′	43·0	20·5	0·81	0·04	.....	
			112′-122′	39·5	23·1	1·22	0·03	.....	
			122′-132′	51·1	15·0	0·98	0·04	.....	
			132′-142′	54·1	15·0	0·53	0·06	.....	
			142′-152′	42·7	17·6	0·90	0·35	.....	
			152′-162′	41·7	18·5	0·64	0·12	.....	
			162′-172′	45·1	18·0	0·88	0·07	.....	
			172′-182′	47·0	17·5	1·18	0·11	.....	
			182′-192′	47·9	16·8	0·73	1·38	.....	
			192′-202′	38·2	21·8	0·96	1·49	.....	
			202′-212′	47·9	12·6	0·62	0·90	.....	
			212′-222′	51·6	13·8	0·91	0·14	.....	
			222′-232′	49·5	16·6	0·96	2·43	.....	
			232′-242′	53·5	13·4	0·81	0·08	.....	
			242′-252′	56·5	12·6	0·67	0·08	.....	
			252′-262′	55·3	7·9	0·70	0·13	.....	
			262′-272′	48·5	15·3	1·09	0·13	.....	
			272′-282′	42·6	19·1	0·71	0·09	.....	
			282′-292′	48·0	17·3	0·81	0·03	.....	
			292′-302′	45·6	21·1	0·78	0·07	.....	
			302′-312′	51·5	13·7	0·98	0·05	.....	
			312′-322′	52·3	13·0	1·07	0·03	.....	
			322′-332′	54·9	13·3	0·93	0·06	.....	
			332′-342′	50·7	14·6	0·78	0·37	.....	
			342′-347′	59·5	6·5	0·72	0·20	.....	
			347′-353′	.....	.....	.....	18·2	.....	

TABLE No. 3.

Designation of Hole.	Direction of Hole.	Angle of Hole.	Depth of Hole.	Metallic Iron.	Insoluble.	Phosphorus.	Manganese.	Sulphur.	Alumina.	Lime.	Magnesia.	Remarks.
Drill hole No. 7.	N. 75° E.	15°	Feet	%	%	%	%	%	%	%	%	
			0 - 10′	.....	.....	.....	.....	.....	.....	.....	.....	Gravel.
			10′- 29′	.....	.....	.....	.....	.....	.....	.....	.....	Hanging wall, porphyry.
			29′- 40′	36·3	25·0	.....	.....	.....	.....	.....	.....	Iron formation.
			40′- 45′	52·9	12·3	.....	.....	.....	.....	.....	.....	
			45′- 50′	55·1	17·3	0·51	1·0	0·10	1·0	1·3	0·7	
			50′- 55′	53·8	19·7	0·49	0·8	0·07	0·4	1·5	0·5	
			55′- 61′	51·3	18·8	0·50	1·1	0·37	0·3	1·3	0·6	
			61′- 62′	.....	.....	.....	.....	.....	.....	.....	.....	No core.
			62′- 63′	55·1	12·6	.....	.....	.....	.....	.....	.....	Iron formation.
			63′- 65′	.....	.....	.....	.....	.....	.....	.....	.....	High in sulphur.
			65′- 71′	52·5	19·2	0·81	1·2	0·11	0·1	1·9	0·4	Iron formation.
			71′- 78′	52·7	17·5	0·73	1·2	0·10	0·1	1·8	0·4	
			78′- 83′	53·5	15·9	0·71	2·0	0·13	0·2	1·7	0·3	
			83′- 88′	28·6	39·9	.....	.....	.....	.....	.....	.....	
			88′- 92′	48·2	17·7	.....	.....	.....	.....	.....	.....	
			92′- 99′	55·6	13·0	.....	.....	.....	.....	.....	.....	
			99′-106′	54·2	14·1	.....	.....	.....	.....	.....	.....	
			106′-109′	46·6	28·5	.....	.....	.....	.....	.....	.....	
			109′-129′	.....	.....	.....	.....	.....	.....	.....	.....	Porphyry and iron pyrites.

Mining Operations.—So far, actual mining operations have been confined to the north end of deposit No. 1. The ore is won by overhand stoping from an open-cut about 75 feet high, trammed and hoisted up an inclined trestle to a No. 8 Gates crusher from which it passes to a picking belt, where it is hand picked by boys, and conveyed to a storage bin for loading into railway cars.

The power plant consists of 3 horizontal boilers, 125 H.P. each; an air compressor of 8 drills capacity, and a 200 H.P. engine. Other buildings erected are: office, manager's house, blacksmith and carpenter shops, storehouse, loading house, and several houses for lodging the staff and miners.

During 1910, about 5,000 tons of ore were reported as having been shipped.

IRON ORE DEPOSITS AT BESSEMER, IN MAYO TOWNSHIP, COUNTY OF HASTINGS.

In the beginning of October, an investigation of the iron ore deposits along Central Ontario railway was commenced by the writer, assisted by Mr. W. Morrison. The season's field work was confined to Bessemer in Mayo township, where a number of magnetite deposits occur on lots 1, 2, 3, and 4, concession VI. A. magnetometric survey was made of lot 4, extending the survey of lots 1, 2, and 3,

made by Mr. Fréchette in 1907, and published in the Summary Report of the Mines Branch for 1908. In addition to the magnetometric survey of lot 4, lots 1, 2, 3, and 4, were topographically surveyed.

History.—The first discovery of ore at Bessemer dates back to 1898, and in 1902 the Mineral Range Iron Mining Company was organized by Mr. H. C. Farnum to take over certain iron bearing properties in the townships of Dungannon and Mayo. The first shipment of ore was made in 1901, the ore being hauled by team to L'Amable station—a distance of about 5 miles. In 1906, a branch line called the Bessemer and Barrys Bay railway, was built, connecting the village of Bessemer with the Central Ontario railway at a point about 1 mile south of L'Amable station. Mining operations were carried on by the Mineral Range Iron Company, until the beginning of 1908, when the properties were leased to the Canada Iron Furnace Company. This Company continued operations until April, 1910, when the lease was allowed to expire, and since then, no mining operations have been carried on.

The following table gives the total amount of ore shipped:—

1901	3,000	short tons.
1902	1,396	"
1903	50	"
1904	....	
1905	....	
1906	2,500	"
1907	20,660	"
1908	28,956	"
1909	19,635	"
1910	7,356	"
Total	83,553	"

Geology.

The area under consideration is underlain chiefly by granite and dark coloured basic metamorphic rocks, interstratified with bands of crystalline limestone. The chief constituents of these metamorphic rocks, classified under the general name of amphibolites, are plagioclase and hornblende, replaced in part by pyroxene or biotite.

They are believed to represent highly altered sediments, or at least to contain sedimentary material, and are invaded and penetrated by the granite.

Ore Deposits.—The ore deposits occur as isolated lenses of varying extent, associated with the amphibolites, along, or adjacent to, the granite contact. The general strike of the formation is northeast-southwest, with a steep dip towards the southeast, averaging about 60 degrees. The ore consists of a fairly coarse-grained, crystalline magnetite, and its quality varies greatly in different parts of the field. In some cases a clean magnetite of high iron content is observed; in others the magnetite is closely associated with epidote, garnet, hornblende, and calcite, and often appears to pass gradually into such gangue minerals. The best quality of the ore averages about 54 per cent of iron, but considerable cobbing has had to be done

in order to keep it up to that standard, since a large percentage of the ore does not average more than 40 up to 48 per cent. This latter has so far been relegated to the waste dumps, or left in the mine. Locally, stringers and patches of iron pyrites are found, making the average percentage of sulphur in the ore rather high. It has, however, been possible, by handcobbing, to keep the sulphur down to somewhere near 0·06 per cent. The percentage of phosphorus is very low, averaging from 0·010 to 0·025 per cent.

An average analysis of the shipping ore supplied by the Canada Iron Furnace Company, Midland, Ontario, is as follows:—

	Per cent.
Metallic iron (Fe)	54·29
Lime (CaO)	6·86
Magnesia (MgO)	1·35
Alumina (Al_2O_3)	2·02
Silica (SiO_2)	9·84
Phosphorus (P)	0·019
Sulphur (S)	0·062

An average analysis of 25 carloads shipped to Midland during 1908, is as follows:—

Iron	54·0
Sulphur	0·075
Phosphorus	0·022

Two average samples of discarded ore taken by the writer from No. 4 mine, gave the following analysis:—

	No. 1.	No. 2.
Metallic iron (Fe)	47·70	42·50
Lime (CaO)	8·75	13·05
Magnesia (MgO)	4·07	2·80
Alumina (Al_2O_3)	2·34	2·79
Silica (SiO_2)	15·30	19·20
Phosphorus (P)	0·004	0·30
Sulphur (S)	0·63	0·30

The ore bodies occur in four groups, which have been designated as mines No. 1, No. 2, No. 3, and No. 4.

No. 1 is situated on lot 1, concession VI. The magnetometric survey indicates here the presence of a number of small lenses of magnetite of little economic importance.

At No. 2 mine, which is situated on lot 2, concession VI, an open-cut reveals some magnetite intermixed with various gangue minerals. The magnetometric survey indicates, however, this deposit to be a mere pocket. It also shows the presence of a few other deposits east of No. 2, but of comparatively small extent.

No. 3 mine is situated on lot 3, about 1,300 feet east of No. 2. It consists of two open pits, which have been opened up on two ore-lenses, separated from each other by about 50 feet of gangue rock. From these pits a considerable amount of ore has been mined. Besides these ore lenses, the result of the magnetometric survey indicates, a short distance east and west of mine No. 3, several other deposits. They are, however, of small extent.

Mine No. 4, which is the principal deposit at Bessemer, is situated on lot 4, concession VI. According to the magnetometric survey the total length of this deposit may be estimated at about 1,000 feet, its western end extending 450 feet under Little Mullets lake. The average width of the deposit is roughly estimated to be about 50 feet.

So far, the mining operations have been confined to the eastern half of the deposit, and the greater part of the ore taken from an open-cut 265 feet long, 40 to 60 feet wide, and with a maximum depth of about 60 feet. At the west end of the open-cut, an inclined shaft has been sunk, following the dip of the ore body. The vertical depth of the shaft is 100 feet, with stations and levels cut at a depth of 50 and 94 feet. Ore has also been mined on the west side of the shaft, where, for a distance of about 100 feet, the ore has been stoped out between the 50 and 94 ft. levels. In width, the stope varies from 29 to 17 feet, with its north side still in ore. The ore is here, however, of low grade, highly mixed with gangue minerals, and also carrying a rather high percentage of iron pyrites, and has, therefore, been left.

Owing to the irregular geological relations of the ore deposits, and the small amount of prospecting work done, no definite estimate of the horizontal extent of the ore bodies can be made. But judging from the results of the magnetometric surveys, confirmed by the distribution of a few natural exposures, we may estimate the total ore area of the four lots to be about 81,000 square feet, divided as follows:—

Lot 1, concession VII	7,000
" 2, " "	6,000
" 3, " "	20,000
" 4, " "	50,000
Total	83,000

This estimate does not, however, pretend to be more than a very rough approximation; besides, a considerable portion of this area contains ore which has either too low iron content, or contains too much sulphur to be suitable for economic iron smelting without previous concentration; a process to which the ore is well adapted on account of its physical character.

Regarding the extent of the ore in depth, mining operations at No. 4 have proved this deposit to a depth of 100 feet below the surface; but both the geological appearance and the result of the magnetometric survey indicate a considerably greater depth.

INVESTIGATION OF IRON ORE DEPOSITS AT TORBROOK, ANNAPOLIS CO., N.S.; AND MAGNESITE DEPOSITS, TOWNSHIP OF GRENVILLE, ARGENTEUIL CO., QUE.

Howells Fréchette, M.Sc.

I.

In accordance with instructions, I spent the summer season of 1910 examining the western portion of the Torbrook iron ore deposits for the purpose of determining the position of the ore beds, and the possibility of tapping the ore at other points than along the present known lines of outcrop.

The area under examination was about $1\frac{3}{4}$ miles northeast and southwest, by 2 miles northwest and southeast. It is situated directly to the east of the Nictaux river about 5 miles southeast of Middleton, Annapolis county, Nova Scotia.

The northwest portion of this district has an altitude varying from 320 to 400 feet above sea-level, and the southeastern from 400 to 575 feet. Intervening is a valley through which the Torbrook or Black river flows, the bottom of which grades from 350 feet to 230 feet above the sea.

The history and general description of the iron ore deposits of this locality are dealt with by Dr. J. E. Woodman in his report on the Iron Ore Deposits of Nova Scotia[1]; part II, chapter II. The geology and stratigraphy have been described by Prof. L. W. Bailey[2], and the late Mr. Hugh Fletcher[3].

There are two principal zones of ore parallel to one another, and distant about one mile. One is on the northwest side of the area under examination, which, for convenience, will be referred to as the north side, and the other across the valley of Black river near the southeast side of the area. This will be referred to as the south side, or, as it is locally known, South mountain.

The ore is in beds conformable with the slates and quartzites, in which they occur. The strike of the beds is N.40° E.[4] On the north side there are two main beds dipping about 80° to the southeast. The northernmost, or "Leckie," is a hard hematite, which is slightly magnetic. About 75 feet south of this is a bed of fossiliferous magnetite, known as the "Shell" bed. On South mountain only one bed is seen. The dip of this is from 78° to 87° to the northwest. The ore in most parts of this bed is a low grade magnetite containing a few fossils. It is highly siliceous, and is of a waxy lustre.

It has been contended by previous observers, that the strata lie in a syncline, and that the bed seen on South mountain is identical with one of those on the north side.

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[1] Publication No. 20, Mines Branch, Department of Mines.
[2] Geol. Survey Annual Report, Vol. IX, p. 91 M.
[3] Geol. Survey Annual Report, Vol. XVI, p. 302 A.
[4] All bearings are referred to astronomic north.

Mr. Fletcher, in his report for 1905,[1] states that certain investigations at the old mines in the eastern portion of the Torbrook district seem to prove that, the rocks lie in several synclines.

If there is multiple folding in the area under present examination, and the folds are large, the ore beds might be expected to outcrop or approach within workable distance of the surface within the Black River basin. However, there is insufficient evidence to be seen in the dip and sequence of the strata to make it possible to state that there is multiple folding here.

SURVEYS.

Magnetometric surveys were made on both the south and north sides of the area, with lines of observation connecting.

South Side.—A base line 6,400 feet long, approximately following the line of pits in the South Mountain ore, was laid off, and cross lines were turned at intervals of 300 feet, and in some places intermediate lines were run. The length of the cross lines averaged 1,700 feet to the north of the base line and 1,250 feet to the south. Magnetometric observations for vertical and horizontal intensity were made at intervals of 50 feet along these lines, and at such other points as were deemed necessary. It had been hoped to locate the presence of additional beds and discover lines along which the ore beds approach the surface, due to multiple folding. Unfortunately, no such results were obtained, but the known bed was traced from the pit on Obadiah Brown's farm westward to Black river. Only one marked break in the continuity of the bed was observed. The maps issued with the reports of Fletcher and Woodman show an offset of the bed at Black river. The line of outcrop from the east is shown as meeting the river immediately below the mouth of a small creek and the line of outcrop from the west as meeting Black river at a point about 1,100 feet below. This was found to be incorrect. The bed *crosses* Black river at the point 1,100 feet below the mouth of the creek and shows no jog. No outcrop was found above this point on Black river, nor did the magnetometer indicate magnetic disturbances.

North Side.—A base line 8,850 feet long was run, parallel to the south base line, near the north beds. Cross lines were run at intervals of from 50 feet to 200 feet, averaging in length 650 to the north of the base line and 450 feet south. Magnetometer readings were taken at intervals of 50 feet along these lines, and in the neighbourhood of the ore, additional readings were taken every 12′-6″. Besides the two main beds, a number of other beds were observed, and their relative position determined. These other beds do not appear to be of any practical importance. The presence of numerous faults was noted.

In connexion with the magnetometric surveys a topographic survey was made by the transit-stadia method, a plan of which is in course of preparation.

NATURE OF ORE.

South Mountain.—The following analyses, taken largely from Woodman's report, will serve to show the character of the ore on South mountain.

[1] Summary Report of Geol. Survey, 1905, page 120.

Analysis of South Mountain Ore.

Sample Numbers.	1	2	3	4	5	6	7	8
Metallic iron	22·92	33·60	47·88	55·69	47·09	49·51	36·41	34·73
Insoluble matter	58·62	40·17	16·75	15·48	(20·20*)	(19·56*)	.....	.....
Alumina					3·70	5·46	.....	.....
Lime					4·55	2·15	.....	.....
Magnesia					0·45	0·90	.....	.....
Phosphorus					1·39	0·745	.....	.....
Sulphur					0·051	0·009	.....	.....
Titanic acid				nil	....	....	.....	.....

* Silica.

Analysis of South Mountain Ore.

Sample Numbers.	9	10	11	12	13	14	15	16	17
Metallic Iron	34·72	55·45	54·53	36·41	48·03	45·82	43·40	46·64	30·88
Insoluble matter	20·49	13·03	(12·68*)	.....	(19·11*)	(22·16*)	.....	.....	(33·16*)
Alumina			2·50	.....	6·20	4·93	.....	.....	
Lime			0·95	.....	2·95	4·15	.....	.....	
Magnesia			0·43	.....	0·38	0·42	.....	.....	
Phosphorus	3·192	.....	1·00	.....	1·32	1·44	.....	.....	1·738
Sulphur		0·003	.....	0·005	0·01	.....	.....	.....	

* Silica.

(1) Selected sample of best "ore" from a pit on the west bank of Black river at the point where the South Mountain bed crosses the river.

Nos. 2 to 17 were also taken from this bed at various distances northeasterly from Black river.

(2) Average sample taken from an outcrop 1,100 feet from Black river.

(3) Sample from a pit 2,100 feet from Black river.

(4) Sample from a pit 2,250 feet from Black river.

(5) Sample from dump beside a pit 2,650 feet from Black river.

(6) Sample from the same pit as No. 5.

(7) Sample selected from a 3 ton dump beside a trench 3,000 feet from Black river.

(8) Sample from a 4 ft. belt of ore in the same trench as No. 7.

(9) and (10) Samples from the same trench as Nos. 7 and 8.

(11) Samples selected from a 2 ton dump beside a pit on the east side of S. McConnell's farm, 3,400 feet from Black river.

(12) Sample selected from the main belt of ore in the same pit as No. 11.

(13) Sample selected from a 1 ton dump beside a pit 4,000 feet from Black river.

(14) Sample from a 4 ft. belt of ore in the same pit as No. 13.

(15) Sample selected from a 1 ton dump beside a pit on Obadiah Brown's farm, 5,900 feet from Black river.

(16) and (17) Samples from the same pit as No. 15.

It will be noted that in most places the ore is very low in iron, and highly siliceous. The analyses which show high iron content are from picked samples, or are samples from narrow bands in the ore bed.

The bed is made up of alternate narrow bands of ore and slate. The widest of these ore bands seldom attains a thickness of more than 5 feet. The aggregate thickness of ore averages about 8′-4″ in a total bed thickness of 18′-10″. These figures are from sections measured by Mr. Fletcher.

Considering the South Mountain bed as a whole, in this section it can hardly be looked upon as showing much commercial possibility on account of the low-grade character of the ore, and the difficulties of transportation.

North Side.—The "Shell" bed, as before stated, is magnetite containing numerous fossils of lower Oriskany or Eo-Devonian age. On page 14, part I, of Woodman's report, he gives the following average analysis of the shell ore. This is compiled from analyses from various sources:—

	Percentage.	No. of analyses.
Iron	44·132	81
Silica	16·605	81
Alumina	4·843	6
Lime	6·790	7
Phosphorus	0·750	25
Sulphur	0·098	11

There are a number of openings in this bed from which ore has been shipped, but at present no ore is being mined. The chief of these—known as the Wheelock mine—was opened in 1905. The ore was shipped to Londonderry, N.S., until 1908, when the mine was closed. The following analysis is given by Woodman as the average of ore shipped:—

	Per cent.
Iron	43·693
Insoluble	17·460
Phosphorus	1·110

About 3,500 feet west of the Wheelock mine the shell bed has been stripped for a distance of about 500 feet. The bed here is 4 feet wide. A general sample gives the following analysis:—

	Per cent.
Iron	53·92
Insoluble	8·25

On the west side of the Bloomington road a sample was taken from some ore lying near an old pit. It gives the following analysis:—

	Per cent.
Iron	51·49
Insoluble	15·37

The average thickness of the shell bed is 5 feet.

The Leckie bed, which averages 4′-6″ in thickness, is of hematite, practically devoid of fossils. In the western part of the field this ore is slightly magnetic. An average of numerous analyses is given by Woodman as follows:—

	Percentage.	No. of analyses.
Iron	49·427	250
Silica	14·868	55
Alumina	4·168	15
Lime	4·235	11
Magnesia	0·534	9
Manganese dioxide	0·591	11
Phosphorus	0·952	75
Sulphur	0·071	17

The Canada Iron Corporation has opened a mine in this bed, about 2,000 feet west of the Wheelock mine. The shaft is down 500 feet. There are five levels on both sides of the shaft. On the west side, they all measure about 325 feet in length; while on the east side they vary from 150 feet to 650 feet. Cross-cuts have been driven from the 2nd and 5th levels to the shell bed, which at this point is 100 feet to the south. In the levels the ore is found to vary in thickness from 3′-9″ to 6′-6″, with an average of 5 feet.

During the past year about 11,000 tons of ore were shipped, which ran about 48 per cent in metallic iron, and 1·5 per cent in phosphorus.

The total quantity of ore raised from this mine was about 55,000 tons at the end of 1910.

At present all the ore shipped is crushed to 3″, and passed over Zimmer shaking tables, where it is hand picked. By further concentration the percentage of iron might be increased materially, as the ore carries considerable included rock.

Transportation.—The ore is shipped over a branch line to the Halifax and Southwestern railway at Nictaux, a distance of about 3½ miles, thence to Port Wade, where a large ore dock has recently been built, or to Middleton where connexion is made with the Dominion Atlantic railway. At present all the ore is shipped to Port Wade, a distance of 55 miles from the mine, and there transferred to vessels.

During the season's work at Torbrook, Mr. A. B. Clark of Bear River, N.S., ably filled the position of field assistant.

II.

In November I visited the magnesite deposits in the township of Grenville, Argenteuil county, Quebec.

Quarrying operations have recently been renewed on lot 18, range XI, in a deposit of magnesite. A small plant has been installed, equipped with a steam derrick, and a small air compressor to supply air to the drills.

The covering of earth has been removed from the magnesite over a considerable area, and a few test pits sunk; but the limits of the deposit have not been revealed. The deposit has been proved for 300 feet north and south, and 60 feet east and west. A porphyritic basalt dyke 1 foot wide crosses the deposit immediately to the north of the quarry pit.

Of the following analyses No. 1 is from an average sample taken from the face of the quarry, which is 20 feet in height; and No. 2 from a surface sample representative of the exposed portion of the deposit:—

	No. 1.	No. 2.
Magnesia (MgO)	42·00%	35·67%
Lime (CaO)	7·40	13·48
Ferric oxide (Fe_2O_3)	0·17	0·40
Silica (SiO_2)	1·67	4·27
Carbon dioxide (CO_2)	47·56	42·96

or otherwise expressed:—

	No. 1.	No. 2.
Magnesium carbonate ($MgCO_3$)	79·70	61·80
Calcium carbonate ($CaCO_3$)	13·21	24·07
Magnesia (MgO) other than in form of carbonate	4·05	6·24
Silica (SiO_2)	1·67	4·27
Ferric oxide (Fe_2O_3)	0·17	0·40

The magnesite is hauled in winter to Calumet, a distance of 13 miles. From thence it is shipped over the Canadian Pacific railway to Montreal. The carbon dioxide is extracted and saved, and the residue goes to the paper makers.

Lot 15, range IX, of the same township, was also visited. On the north half of this lot there is a deposit of magnesite, which appears to be about 200 feet in width, and of unknown length. The magnesite is of very good grade in places, but in others carries considerable chondrodite. It was impossible to gain any definite knowledge of this deposit, or to gather representative samples, as the ground was covered with snow at the time of visiting.

SESSIONAL PAPER No. 26a

INVESTIGATION OF REPORTED DISCOVERY OF TIN ORE IN THE VICINITY OF ARNPRIOR, ONT.

L. Heber Cole.

I.

In accordance with instructions, I left Ottawa on August 30, 1910, for Arnprior, Ont., to look into the truth of the reported discovery of tin ore in that vicinity.

On making inquiries, I was referred to Mr. Claud McPhee of Arnprior, who has the property on which the reported discovery was made under option. Permission was obtained to examine and take samples. I drove out to the property, but found the shaft full of water; and as there was nothing to be seen on the dump, postponed my examination until the shaft was dry.

Having been informed that the shaft was unwatered, I again visited Arnprior in the first week of December and made a thorough examination: taking samples where advisable.

The property is situated in Carleton county, Fitzroy township, about 1½ miles northwest of Galetta—a station on the Ottawa, Arnprior, and Parry Sound railway. The lots cover an area of about 1,000 acres.

The property was first opened up prospecting for galena and zinc blende. The rock of the district is highly altered, and consists of alternating bands of decomposed granites, hornblende schists, and crystalline limestone. These bands strike northeast and southwest, and dip to the northwest at about 70°. The vein, which lies along the contact between the limestone and schist, consists of badly disintegrated calcite, barite, and feldspar; but on this property it is not very well exposed. The thickness is variable, averaging about 2 feet.

Two openings have been made on the contact: one a shaft, and the other an open-cut. The shaft has one compartment, is 45 feet deep, and a cross-cut has been driven from the bottom, 15′-0″ into the hanging wall. The open-cut consisted in stripping the overburden for a length of 15 feet, a width of 4 feet, and a depth of 6 feet.

The material on the dump at the shaft consists of calcite, barite, and crystalline limestone, carrying occasional specks of zinc-blende. Crystals, more or less perfect, were found of both calcite and barite.

Shaft.—This was sunk on the vein for the first 20 feet, at which depth the latter goes off in the hanging wall, the shaft being vertical. The walls show calcite in crystalline form for this distance, and then the limestone country rock with cross stringers of quartz holds to the bottom. The cross-cut showed up the vein about 10 feet from the hanging wall of the shaft, but was abandoned because the vein was very porous, and open to the surface, allowing surface waters to penetrate, carrying with them considerable clay and rounded pebbles (about 1″diameter). This clay material, which can be dug out by hand, fills in the spaces around the

calcite crystals which have formed to considerable size in the cavities of the vein. Zinc-blende is found scattered throughout the altered limestone on the contact with the vein, and several lumps about 2″ diameter were found, and taken for a sample. No indication of any other economic mineral was found.

Samples were taken as follows from the shaft:—[1]

	Cassiterite.
No. 1—5 feet along east wall of cross-cut across vein..	Nil.
No. 2—6 feet along north side of shaft, 40 feet from collar.....	Nil.
No. 3—General sample from material in bottom of shaft and cross-cut.....	Nil.
No. 4—Sample of clay in cavities.....	Nil.
No. 5—Vein in back of cross-cut, 2 feet across.....	Nil.
No. 6—Special sample (mostly zinc-blende) picked from walls in cross-cut.	

Open-cut.—This shows much iron stain and chlorite, formed by the alteration of an iron-bearing mineral, probably hornblende. The hanging wall consists of mica schist, and all the rocks appear greatly altered. This pit is about 100 yards to the northwest of the shaft.

A sample was taken from the centre of the east breast, where the rock showed a schistose structure, and contained several garnets.

	Cassiterite.
No. 7—Sample from open-cut.....	Nil.

On examining and testing all these samples thoroughly, the analyst failed to find a trace of cassiterite.

Judging from samples taken, the appearance of the prospect, and other conditions, there is not much likelihood of tin being found in this district.

II.

COBALT AND SURROUNDING DISTRICTS, PROVINCE OF ONTARIO.

In accordance with instructions, I left Ottawa on September 1, 1910, to obtain information regarding the mining operations being carried on at Cobalt, and the surrounding country; special attention being paid to the concentration of the silver-cobalt ores. A hurried trip was also made into the Porcupine gold camp.

The respective districts are dealt with in the following order:—

(1) Cobalt silver district,
(2) Gowganda and Elk Lake silver district,
(3) Shiningtree and Rosey Creek silver district,
(4) Porcupine gold district.

A map showing the relative positions of the districts and the principal lines of transportation, has been prepared, and accompanies this report at the end.

Appreciative acknowledgment is due to the mine managers and engineers of the districts investigated for their courtesy and readiness in furnishing information; which greatly facilitated the work.

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[1] Analyst, M. F. Connor.

THE COBALT SILVER DISTRICT.

In 1904, Canada stood eighth in the list of silver producers throughout the world. In the same year the Cobalt district first came into prominence, and shipped its first ton of cobalt ore. The following table shows the influence that the phenomenal production of this camp has had on Canadian production of silver; the rest of Canada having increased its output only slightly during these years:—

1904	Canada stood	8th	in the list of	producers.		
1905	"	"	6th	"	"	"
1906	"	"	5th	"	"	"
1907	"	"	4th	"	"	"
1908, 1909, 1910	"	"	3rd	"	"	"

The following table shows the production, in 1909-1910,[1] of several of the more important silver producing countries:—

	1909.	1910.
Mexico	73,949,432 ounces.	72,574,220 ounces.
United States	54,721,500 "	54,438,695 "
Canada	27,529,473 "	31,983,328 "
Australia	16,359,284 "	16,359,284 "
South America	16,038,182 "	16,476,928 "

The output in 1910, for the Cobalt and surrounding districts was 29,375,000 ounces: after deducting 5 per cent from the settlement assays of ores sent to the smelters to allow for smelting losses. This is an increase of about 4,552,900 ounces, or about 18 per cent more than the production of 1909. Taking the average value of the price of silver for the year 1910 as 53·486 cents, the value of the Cobalt shipments was over $15,711,513.

Shipments.—The shipments from the Cobalt camp have shown a steady increase from year to year:—

1904	191·55 tons.
1909	29,942·99 "
1910	33,976·97 "

These figures are the shipping weights recorded in the office of A. A. Cole, Mining Engineer, to the Timiskaming & Northern Ontario Railway Commission.

The Cobalt ore shipped during the twelve months of 1910 was distributed as follows:—

Canada	9,922·40 tons	or	29·20 per cent.
Great Britain	393·73 "	"	1·15 "
U. S. A.	23,428·70 "	"	68·96 "
Germany	232·14 "	"	0·69 "
Totals	33,976·97 tons	or	100·00 per cent.

[1] Eng. and Min. Journal.

The value of the ore handled in the Canadian smelters is over 50 per cent of the total production of the district. Although the United States is taking a considerably larger tonnage, this is due to the fact that in Canada only a very small percentage of the low grade ore is being treated.

Power.—Three companies, having developed some of the water-powers of the district, are now supplying power to the mines at Cobalt for about $50 per horse-power per annum. This power development has greatly reduced the operating costs of the mines, which before were dependent on steam-power at an average cost of $150 per horse-power per annum. The companies supplying power to the camp are:—

The British Canadian Power Co . . . compressed air and electricity.
The Cobalt Hydraulic Power Co. . . compressed air.
The Cobalt Power Co. . . . . electricity.

The first of these corporations develops its power at the falls on the Matabitchuan river—a few miles from where it enters Lake Timiskaming; while both the other companies are developing power at falls on the Montreal river. The Cobalt Hydraulic Power Company employs the Taylor system of compressor. The total power development is about 16,000 potential horse-power.

Prospecting.—Surface prospecting is carried on by a system of cross-trenching, into blocks 50 feet square; following this up with complete stripping where ground is promising. One company is installing a complete hydraulic plant, with monitor, and the ensuing summer will see a considerable area laid bare, by means of a powerful stream of water, which will wash the overburden into Cobalt lake.

Mining.—The veins, as a rule, are nearly vertical, hence, with very few exceptions, the mines have adopted vertical shafts, having levels varying between 60 and 100 feet apart, according to the regularity of the veins.

Two methods of underground development are being followed. The first is by driving a drift alongside the vein, leaving the vein on the wall, and breaking it down separately, as required. This reduces the fines to a minimum. The other method, which has been adopted more frequently of late, is to keep the vein in the centre of the drift. This has the advantage of prospecting both walls on each side of the vein: a matter which is seen to be of great importance in many of the mines, on account of a larger number of the veins having walls which are heavily impregnated with silver.

Concentration.—From the very beginning it was known that concentration would play a very prominent part in the life of the camp. The ores found were unique, and afforded concentration problems never before encountered in any part of the country. Since there were no precedents on which to work, the operating process had to be worked out from the beginning, and experiments were made on small lots at the various mining schools and testing plants in Canada, and at many similar plants in the United States. These investigations led to the establishment of concentrators, three of which were put in operation before the end of 1907, while others were under construction.

There are now fourteen mills in active operation, and several others in contemplation. The mills at present working are treating about 1,350 tons of low-grade ore each day. This ore will average 20 to 25 ounces silver per ton. The losses

in the tailings vary greatly according to the method of treatment and with the grade of ore treated, and will range from 2 to 6 ounces per ton. Recovery averages about 80 to 85 per cent of the total silver content of the ores.

The method of treatment varies among the different mines, but most of them employ a system of water concentration alone; while a few employ the cyanide treatment, either wholly, or in combination with water concentration. Considering the peculiar difficulties which have had to be overcome, and the extremely rapid growth of this branch of the work in the camp, the results now being obtained are remarkable, and reflect great credit on the men who have undertaken this work so systematically. New improvements are constantly being put into practice, so that young though the camp is, the results obtained compare favourably with the other silver camps on the continent.

Sampling.—A customs sampling plant is now in operation in the town of Cobalt; and the returns from this plant are accepted by a number of the mines as a basis for settlement with the smelters.

Smelting.—There were twelve smelters or refineries in the market for Cobalt ores during 1910, representing four countries as follows:—

Canada	6
United States	4
England	1
Germany	1
Total	12

Three of the Canadian refineries were only started in the latter part of the year. None of these purchasers allow anything for the Cobalt content of the ores.

Although the shipments for this district have been steadily increasing, the total reserves have not as yet shown any decrease, but rather an increase. The development and extension of concentrating facilities has made available for treatment a large tonnage of low-grade ore that could not be economically shipped in the early days of the camp. During the year of 1910 there were twenty-nine mines shipping ore, and several others are expected to become shippers during 1911.

THE GOWGANDA AND ELK LAKE SILVER DISTRICT.

This district is situated around the headwaters of the Montreal river, and is sometimes called the Montreal River district. It is the largest silver producer among the camps in the country around Cobalt.

From Cobalt to Gowganda lake—in an air line—is about 55 miles; whereas to Elk lake, the distance is about 33 miles. The routes by which these districts can be reached are very much longer.

Gowganda lake, from which the district gets its name, lies on the boundary between the townships of Nicol and Milner. Elk lake, in the eastern part of the district, is in the township of James.

The route generally used in summer is by boat from Latchford on the Timiskaming & Northern Ontario railway—where the latter crosses the Montreal river. A boat line on this trip makes connexions with the trains on the Timiskaming & Northern Ontario railway, both north and south bound. This route

embraces three portages, and four boats are engaged on the route. It covers a total distance of about 52 miles to Elk City and Smyth—two towns situated on opposite sides of Elk lake at the mouth of Bear creek. From Smyth, a stage runs each day to Gowganda, situated on the northeast arm of the lake of the same name.

The trip is over a Government built road—a distance of 27 miles. The town of Gowganda has a population of about 500 inhabitants. A winter road from Elk City to Charlton—a station on a branch of the Timiskaming & Northern Ontario railway from Englehart—is now being improved by the Ontario Government, so that it may be used the whole year round.

The country in the vicinity of these lakes is very rugged and broken, with numerous ridges, lakes, and swamps. Where the soil permits, it is well wooded with the usual timber of the northern parts of Ontario, mostly of medium size. During the last year or so the forest has been badly devastated by fires.

As the Cobalt district gradually became all staked, the prospectors, searching for fresh territory, ascended the Montreal river and spread out over the adjacent country. The result was, that in the summer of 1907 reports of silver discoveries began to be received from the Gowganda and Elk Lake district; and one of the biggest "rushes" known in the history of Ontario took place. It was estimated that during the winter of 1908-9 over 1,000 teams were at work on the winter road, hauling freight into this district from Charlton.

The mines of the district are much scattered, and, with only one exception, the ores are found in the diabase. The exception is in the conglomerate, and is a vein of smaltite with high silver values.

At the western end of the district, to the west side of Gowganda lake and around Miller lake, a group of mines are steadily at work with small forces ranging from 10 to 100 men on each property; all of which have small, but complete installations of machinery. In the eastern part of the district, the working properties are chiefly along the shores of Elk lake, on the Montreal river. Other properties which are being operated are scattered singly throughout the district.

Considerable underground development has been done on all the properties, mostly at a depth of about 100 feet. Extensive surface prospecting and development has been carried on in a manner similar to that employed in the Cobalt district, namely, by cross-trenching the claim into 50 ft. squares, and then by stripping the veins discovered.

Up to date, the shipments from this camp have come from a small number of mines; although on several new properties ore is sacked and ready for shipment. This winter there should be a substantial increase in the shipments. The following shipments had been made from this district up to the end of December, 1910:—

Mine.	Amount shipped.
Milleret	346·30 tons.
Dobie-Reeve	61·00 "
Miller Lake-O'Brien	31·00 "
Boyd-Gordon	30·00 "
Lucky-Godfrey	17·00 "
Bonsall	6·78 "
Bartlett	2·00 "
Burke-Remey	2·00 "
Welsh	1·25 "
Total	497·33 "

Concentrators, so far, have played no part in the development of this district. There are, however, two mills under construction, one of which is nearly completed. They will serve to demonstrate whether others should be erected.

The district has been greatly handicapped by the lack of good transportation facilities.

THE SHININGTREE AND ROSEY CREEK SILVER DISTRICT.

This district, situated about 15 miles to the south and west of Gowganda lake, has only lately been seriously considered as a possible producer of silver. Development work is only commencing, and no shipments have as yet been made.

Access to the district in summer, although difficult, is feasible by three routes: two by way of Gowganda Junction—a point on the Canadian Northern railway, 69 miles north of Sudbury; and the other from Latchford, on the Timiskaming & Northern Ontario railway, via Elk City and Gowganda. In winter, sleigh roads connect with both these railways.

In summer, one route from Gowganda Junction by canoe is possible through Blue lake, Wigwam lake into Oshawong lake, and the headwaters of the Wanapitei river. Following down this river and turning north into Rosey creek, Shiningtree lake may be reached by hard portaging. Another canoe route is practicable from Gowganda Junction, south through Blue lake; portaging to Pants lake, then through Gladys, Barnett, Prune, and Welcome lakes, into the Wanapitei river; and thence north, via Sylvester creek, to Tracey lake; portaging to Shiningtree lake. Both routes entail considerable portaging, and, therefore, supplies are generally taken in over the winter roads.

Much diabase, similar to that found in the Cobalt district, occurs throughout this area, and most of the veins are found in this rock. The veins of calcite, averaging from $\frac{1}{2}''$ to $3''$ in width, are numerous, and small diabase aplite dykes also appear. The veins carry smaltite, and in some few cases native silver has been found in the loose, cementing material, along the sides of the veins. Near the surface the characteristic cobalt bloom is often found. Other minerals, such as galena, chalcopyrite, stibnite, chromite, and specular iron, occur in these veins, but only in small amounts. In several places samples of an actinolite schist were found in the diorite, badly shattered, varying in width from $\frac{1}{2}''$ to $4''$. The fibres were well

formed, but very brittle. A vein of barite free from impurities, and averaging 12″ in width, was noticed on the north shore of the Wanapitei river, about 2 miles west of the mouth of Sylvester creek.

The work so far done in this district is of a very preliminary nature. Two or three properties are using steam power for hoisting purposes, but most of the work consists of stripping the veins of their overburden. Because of the difficulties of bringing machinery into the district, this method of prospecting proves the simplest and most efficient means of development work for the prospector. In many cases the work has been very systematically undertaken, and has given good results in showing up the veins.

Most of the properties are still in the hands of the original locators, and in only a few cases have companies been formed to operate in this district.

THE PORCUPINE GOLD DISTRICT.

The district known as Porcupine, situated in the northern part of New Ontario, is the youngest mining camp in Eastern Canada. At present, active prospecting is principally confined to the townships of Tisdale, Deloro, Whitney, and Shaw, in the Sudbury district, but many claims have been located in adjoining townships.

The first claims were recorded in the summer of 1906; but very little interest was taken in the findings until the spring and summer of 1909. At present the principal properties are situated in Tisdale township, to the west of Porcupine lake; but the ensuing spring will see active work being carried on in the three other townships mentioned.

The camp is reached in summer by three different routes: two from the Timiskaming & Northern Ontario railway, at mileages 205 (Matheson) and 222 (Kelso) respectively; and the third from Bisco on the Canadian Pacific railway. This latter route is by canoes down the Mattagami river to a point about 3 miles west of Miller lake on the west boundary line of Tisdale township. The most popular route during the past summer was from mileage 222 at Kelso—a distance of 467 miles by rail from Ottawa. From thence, a stage operates for a distance of 12 miles, to the point where the Frederick House river enters the lake of the same name. A gasoline launch service from this place runs up the Frederick House river, across the north end of Nighthawk lake, and up the Porcupine river for a couple of miles to Hill's stopping place. A government road, 6½ miles long—built by convict labour—is completed from the last named place to the north end of Porcupine lake. The Kelso winter road, over which most of the freight is going this winter, follows a more direct route after leaving the mouth of the Frederick House river; and shortens the trip from Kelso to the north end of Porcupine lake to 25 miles.

The Timiskaming & Northern Ontario railway is at present at work on the construction of a branch line into the camp, and it is expected that this will be completed by the end of June, 1911.

There are three townsites in this district: all situated on the shore of Porcupine lake. At the northeast end is the government townsite called Porcupine, and immediately across the lake to the northwest is Pottsville, where the post-office is located. At the southwest end of the lake another townsite has been established.

In summer, a gasoline launch service plies on the lake between the different townsites. The lake is $2\frac{1}{2}$ miles long.

Much of the country is low-lying and swampy, and is covered with a heavy growth of small timber. On account of the impervious clay bed which lies only a few feet below the surface of the swamps, the land is very difficult to drain, and this greatly hinders trenching. The rock outcrops through this overburden in scattered spots throughout the whole district.

At present most of the properties are in the preliminary stages of development. This development consists principally of stripping the loose overburden from the vein, to its full width, by a series of cross trenches, each about 4 feet wide, and averaging 50 feet apart. In some cases the veins are stripped completely. On many of the properties test pits are now being sunk at regular intervals on the vein, with the intention of connecting them later by drifts underground. Of the larger properties, five have shafts down, ranging from 60 to 100 feet in depth; and the owners are now driving cross-cuts and drifts at the depths indicated, to prove up the tonnage. This underground work has been pushed forward at a fair speed considering the disadvantages of the district; so that by the end of December, 1910, 1,500 feet approximately of drifting and cross-cutting had been opened up from the bottom of these workings.

Steam power in the camp has already been developed, to about 500 B.H.P.; for hoisting purposes and running drills, but many of the properties are still using only manual labor.

The installation of electric power plants on the Mattagami river at Sandy falls and Wawaitan falls is well under way.

It is expected that they will be able to furnish sufficient power next summer to run all the stamp mills then in operation.

Three experimental plants, consisting of Nissen or Tremaine stamps, amalgam plates, and tables, have been working on these ores with satisfactory results.

Orders have now been placed for mills of larger tonnage. According to present indications, by the middle of next summer, fully 75 stamps will be dropping in this camp: crushing about 250 tons of ore per day.

A complete telephone system has been established, connecting all the important properties and different townsites, and these in their turn are in direct communication with Kelso and Matheson on the Timiskaming & Northern Ontario Railway telephone system.

Although the Porcupine camp is still in its infancy, it produced in the latter half of 1910, more gold than the whole Province of Ontario produced in 1909. It gives promise of developing several good properties, which may become prominent producers in the list of Canada's gold mines.

ON THE MICA DEPOSITS OF ONTARIO AND QUEBEC.

Hugh S. de Schmid, M.E.

The summer season of 1910 was devoted to an examination of the principal mica regions of Ontario and Quebec; with the object of gathering material for a revised edition of the monograph on mica, issued by the Mines Branch in 1905.

While the chief purpose of the tour was to examine and report upon the mica deposits at present being worked, time was also devoted to an examination of old mines, with the object of collecting geological data bearing on the origin of the mica, and of compiling as complete a map as possible of the localities in which the mineral has been found to exist in commercial quantities. While it was found impracticable to visit every small surface pit from which mica has, in the past, been taken, all available information regarding such was collected, and will be embodied in the full report.

Individual township maps of those districts in which the more important deposits occur, are in process of preparation, and the comprehensive regional maps are being enlarged to a scale of 2 miles to the inch; instead of 3·95 miles, as in the former report. An additional key map, showing practically the entire mica region examined—is also being prepared.

Photographs of the mines and pits were obtained wherever practicable, and specimens showing the typical occurrence of the associated minerals, contacts, etc., were obtained for the purpose of photographing, and for illustrative reproduction.

A number of rock and mineral specimens have been sent to Germany to be prepared for microscopical examination; while a similar examination of the micas from the different mines will be undertaken. A chemical analysis of a number of mica samples is also to be made, for the purpose of determining the possible variations in the percentage of iron contained in the light and dark-coloured varieties.

A large number of the mines were idle and the workings under water, hence no detailed examination of these could be made: and reliance had to be placed on local hearsay for information relating to mining operations; while an examination of dump material and surface formations had to suffice for the gathering of geological data.

A large collection of rock and mineral specimens was made, however, and these should prove sufficient for an investigation into the origin of the mica deposits.

QUEBEC.

Since the original monograph was published in 1905, new amber mica occurrences have been located and worked in Quebec, north of the districts covered by Mr. Cirkel's report, and it would appear that the mica-bearing region extends considerably north even of the area which had already been prospected.

In the Lièvre River district, the most northerly workings are situated a few miles from Notre Dame de Laus, in the township of Bigelow, where Mr. W. Parker of Buckingham has carried on considerable surface work, and discovered extensive deposits of mica on range V, lot 52. The mica is a rather dark amber, and of only medium splitting quality.

In the Gatineau region the mineral has been mined as far north as range II, lot 28, of the township of Egan, where Mr. Joanis of Maniwaki has taken out several thousand dollars worth of fair amber mica.

Prospectors were met with in the vicinity of Pemichangau lake, who reported favourable indications on ranges V and VII of the township of Blake.

The most westerly mica deposits which have as yet been worked in the area under consideration are situated in Litchfield and Huddersfield townships, where Messrs. Bowling Bros., of Thornby, and the Calumet Mica Company of Bryson, have carried on some surface work.

It may be remarked that the mica-bearing dykes (pyroxenites) are to be found cutting the Laurentian rocks throughout almost the entire district situated immediately north of Ottawa and the Ottawa river, and over an area of which the boundaries to the north, east, and west are as yet but poorly defined. The presence of these pyroxenite dykes, while indicative always of a possible occurrence of mica, does not necessarily imply the existence of a commercially valuable deposit. In some districts mica in quantity is to be found in pockets throughout the entire mass of such a dyke, while in others but scanty traces of the mineral are to be met with, though the rock, to all appearances, is identical in both places.

Owing to its occurrence in such sporadic fashion, mica is among the most uncertain, and, from a miner's point of view, one of the most disappointing of minerals to follow. Often when the indications of a continuance in depth of the deposit are most favourable, the fissures narrow down, and all traces of the mica are lost; on the other hand, seemingly barren rock will suddenly yield large quantities of high-grade crystals, which, however, may form only an isolated group, and be underlain by many feet of rock before mica is again met.

While it is not intended to assert that mica in quantity exists on every lot in the region between the Lièvre and Gatineau rivers, the district is nevertheless so extensively traversed by pyroxenite dykes exhibiting traces of the mineral that the possible existence of deposits on almost any lot cannot be said to be precluded.

In addition to the localities mentioned, mica also occurs farther to the east, in Argenteuil county, Wentworth township, where several operators have mined on a small scale. The mica in the last-named district, as in the Saguenay region, Berthier county, still farther to the east, is chiefly of the muscovite variety.

ONTARIO.

The mica-mining region of Ontario has not been extended by any new discoveries of importance since the publication of the last report.

The chief centres of mining activity are Sydenham and Micaville, in the townships of Loughborough and North Burgess, respectively. In the former district,

the General Electric Company's mine—the old Smith and Lacey—still remains the chief producer, and employs an average staff of 35 men. The output and reserves of this mine play an important role in fixing the market price of the mineral, and the General Electric Company, which carries on its mining operations under the name of the Loughborough Mining Company, can be said to practically control the market.

The above Company also owns various other mines in different parts of the country, chief among which are the Cantin mine, on lot 1, range IV of South Burgess township; the Hanlon mine on lot 11, range VI of North Burgess; and the Chaibee mine on lot 7, range A of the township of Wright (Quebec). None of the latter mines were working when visited.

The occurrence of a yellowish, and rather brittle mica, whose composition and exact species have not yet been determined, in a highly metamorphosed rock in the Sydenham district, may be mentioned here as constituting a type of mica deposit in many respects dissimilar to the majority of occurrences visited. The deposit in question is at present being worked by Mr. J. Richardson of Kingston, with an average staff of half a dozen men, and is situated on lot 1, range X, of the township of Loughborough.

The intrusive rock to which the mica probably owes its origin had not, at the time of my visit, been met with—the depth reached by the workings not exceeding 60 feet. The mica appears to have been deposited by pneumatolytic emanations from the igneous intrusion of some basic rock which did not reach the surface, but which will probably be met with at an inconsiderable depth.

Three beds, from 1 to 2 feet thick, of a reddish quartzite, are met with in the workings. These layers contain no mica, and the rock in their immediate proximity is also practically devoid of the mineral.

The source of the mica is, in all probability, a basic laccolite.

A similar mica is also found on lot 5, range II, of Bedford township, this occurrence being almost identical with the foregoing. In this case, however, the country rock is limestone, belonging to the Archæan formation, and is of the normal white, coarsely crystalline type.

The association with the mica of secondary minerals such as vesuvianite, actinolite, garnet, etc., at both the above-mentioned mines, is interesting, and will be further described in the full report.

QUALITIES OF MICA.

With the exception of some half dozen, all the mines and prospects visited, numbering over 200, were concerned with phlogopite, or amber mica deposits. The colour of the mica was found to range from almost black, in which case the resemblance to biotite was very close, to almost colourless: the very dark and the very light-coloured varieties being, as a rule, the poorest splitters.

The suitablity of mica for electrical pnrposes depends essentially on two factors: (1) its degree of cleavage, and (2) its non-conducting properties. Consumers of the mineral seem to vary in their opinions, some preferring a relatively dark mica

of medium splitting quality, while others refuse to take any but the light-coloured variety—on account of its apparent freedom from iron—though its cleavage may be much inferior to that of the dark-coloured.

Brittleness also is an important consideration with consumers, this being a fault which affects both the dark and the light micas.

With the advent, however, of mica-board manufacturing, brittleness has ceased to prove such a detrimental factor, since even the most brittle mica is sufficiently flexible in very thin layers ($\frac{1}{2}$ to 1 mil.) to be used in the building up of mica plate.

Some manufacturers use both dark and light amber mica, and mix in a certain proportion of Indian white mica (muscovite) the resulting plate possessing, it is claimed, all the qualities necessary to the manufacture of electrical appliances.

STATUS OF THE MICA INDUSTRY.

The condition of the mica market, though inclined to show a slightly better tendency, towards the latter part of 1910, has not conduced to any great activity on the part of operators during the past few years. Some few of the larger owners are continuing to work, but practically all the smaller mines are idle.

A peculiar feature is, that while in the Quebec mica districts mining was declared to be unprofitable under present mining conditions, operators in Ontario, while admitting that prices were low, yet contrived to find a satisfactory enough market to enable them to continue working their properties, and even to consider the re-opening of mines which have been idle for some years. The cause of this divergence of opinion is difficult to arrive at, since wages and general mining expenses are, if anything, lower in Quebec than in Ontario.

Owing to this inactivity amongst mica-miners, fully 80 per cent of the mines visited were found to be idle, and the pits more or less full of water, and consequently inaccessible.

Although in the past, Canadian producers have, for the most part, seemed to be content with the market provided by the United States, shipments are now being made in increasing quantity to English consumers, and inquiries were often made during the past season as to names and addresses of buyers in the United Kingdom.

While appreciating the superiority of Canadian amber mica for electrical purposes, English and Continental manufacturers nevertheless still procure the greater part of the mica they require from India.

Subjoined are tables showing the amount of mica imported into the United Kingdom during the past five years from Canada and India respectively, and also the imports of Canadian mica into the United States for the same period.

TABLE 1.

Exports of Mica from Canada to Great Britain.*

Calendar Year.	Tons.	Value.	Average Value per Ton.
		$	$ cts.
1905	179	25,717	143.07
1906	167	58,735	351.71
1907	80	43,913	548.91
1908	156	81,050	519.55
1909	30	24,316	810.53

* Compiled from Mines Branch statistics.

TABLE 2.

Imports of Mica into Great Britain from Canada.*

Calendar Year.	Tons.	Value.	Average Value per Ton.
		$	$ cts.
1905	130	24,349	187.30
1906	209	51,618	246.98
1907	88	51,497	585.19
1908	122	74,362	609.52
1909	34	30,749	904.38.

* Compiled from British Board of Trade Returns, 1910.

TABLE 3.

Imports of Mica into the United Kingdom from India.*

Calendar Year.	Tons.	Value.	Average Value per Ton.
		$	$ cts.
1905	901	369,506	384.50
1906	1,845	782,397	423.15
1907	1,778	672,532	378.25
1908	1,369	415,773	303.71
1909	1,302	480,042	368.69

* Compiled from British Board of Trade Returns, 1910.

TABLE 4.

Imports of Mica into the United States from Canada.*

Calendar Year.	Tons.	Value.	Average Value per Ton.
		$	$ cts.
1905	253	121,560	480.47
1906	539	328,991	610.35
1907	767	596,321	777.47
1908	172	140,166	814.92
1909	107	132,941	796.05

* The Foreign Commerce and Navigation of the United States.

It will be seen that in 1905—the year in which the greatest quantity of mica during the quinquennial period in question was shipped from Canada to English consumers—this quantity was exceeded by the Indian shipments by more than five times; while in 1909, the Canadian mica imports were only one forty-third of the Indian.

A comparison of Tables 2 and 4, showing the average value per ton of the mica shipped to the United States and of that sent to English buyers, discloses a rather remarkable difference of price: in one case (1905) the latter would appear to have paid $336.80 per ton more for their mica than the Americans, while in 1909 the reverse is the case, the prices being in favour of the English consumers by $14.48 per ton.

The accurate average price is not, however, claimed to be shown in the above tables; in fact the figures given in the British Board of Trade returns show discrepancies when compared with those compiled from statements published by Canadian shippers amounting in one year (1906) to as much as $104.73: the average price paid per ton, calculated from the British Board of Trade returns, being $246.98; while the figure arrived at from the statements furnished to the Mines Branch statistical department was $351.71.

A comparison of the figures given in Tables 1 and 2 will show how greatly these two sources of information vary in their statements both as regards tonnage and value.

The cause of the wide difference in value of the English and American shipments, given in the two tables—differences which render any sort of comparison futile—is probably to be found in the various grades of mica shipped to the different countries.

Shippers, being bound by no compulsory system of classification or grading other than may be agreed upon between themselves and the buyers, may, in one instance, forward a consignment of more or less roughly trimmed mica of comparatively low unit value, while to another purchaser only high-grade sheets are sent, the difference in value of equal weight shipments being accordingly very great, while both consignments would be similarly classed in the Trade Returns as "mica," without distinction as to quality.

It is worthy of remark that, while the yearly average unit value of the Indian mica imported into the United Kingdom in the five years shows a maximum variation of $119.44, that of the Canadian mica similarly imported reaches the high figure of $691.97 (mean value calculated from Tables 1 and 2).

The comparatively small difference in the case of the Indian mica is doubtless due to the standard quality of the mineral, which varies little in colour and general character (elasticity, brittleness, etc.) whereas the amber mica possesses all these attributes in greatly varying degree—its price varying accordingly.

It is due to the fact that the Indian mica can always be depended upon to be of the same standard quality, that buyers in the United Kingdom have generally preferred this variety to the amber, which can seldom be relied upon, even in a single shipment, to be of uniform grade and colour.

Canadian producers, while realizing this, yet appear reluctant to fall in with the wishes of the English market, and cannot agree to the request of prospective purchasers in the United Kingdom to furnish shipments which are uniform in quality with samples submitted by them.

There can be no doubt that, could a satisfactory system of sorting be devised and agreed upon amongst mica dealers, the market relations and conditions between Canada and Great Britain would be materially improved.

For the purpose of further emphasizing the discrepancy between tables calculated from returns furnished by shippers on the one hand and by Foreign Trade returns on the other, an additional table (5), of exports of Canadian mica to the United States, is given: the figures here given are taken from "Trade and Navigation."

TABLE 5.

Exports of Mica from Canada to the United States.*

Calendar Year.	Tons.	Value.	Average Value per Ton.
		$	$ cts.
1905	351	150,767	429.62
1906	735	519,479	706.77
1907	468	372,798	796.58
1908	132	115,005	871.25
1909	325	229,689	706.74

* Trade and Navigation.

The following table (6) gives the total annual production of mica in Canada for the same period:—

TABLE 6.

Total Annual Production of Mica in Canada.[1]

Calendar Year.	Tons.	Value.
		$
1905	...	178,235
1906	574	303,913
1907	774	312,599
1908	436	139,871
1909	369	147,782

[1] Mines Branch returns.

The fact that, in some cases, the total annual production falls short of the combined exports to Great Britain and to the United States for the year, is due to the practice made by some producers of accumulating large stocks of mica: these reserves, in many cases, remain on the mine, and so do not figure in the production returns.

At the present time, large quantities of mica are being held in reserve, which owners are not disposed to ship at current prices.

PRELIMINARY REPORT ON THE BUILDING AND ORNAMENTAL STONES OF ONTARIO: SOUTH OF THE OTTAWA AND FRENCH RIVERS.

Dr. W. A. Parks.

Pursuant to instructions, I spent three and a half months of the field season of 1910 in making an examination of the stone quarries of the southern part of Ontario. The inquiry was conducted with the object of ascertaining the status of the building stone industry and it was restricted to that part of Ontario lying south of the Ottawa and French rivers. It is proposed to issue the report as the first part of a work on the Building and Ornamental Stones of Canada.

In addition to examining the quarries in Ontario, I spent a week in the granite and in the marble areas of Vermont, as well as a short time in the slate region of western New York. The quarries of the Missisquoi Marble Company at Philipsburg, Que.,were also visited.

Limestone, sandstone, granite, and marble are quarried in the Province; but although the outlook is bright in certain directions, it cannot be said that the industry as a whole is in a flourishing condition. In all, 240 quarries were visited; but of these only about 70 are at present actually producing stone. This number includes certain quarries in which building stone is produced incidentally only to operations for crushed stone or lime. Quarries known to be worked for lime making only, are not included in the figures given above. As far as I am aware, all quarries at present producing building or ornamental stone were examined; but it is not to be supposed that the numbers given above include all openings from which building stone may have been obtained from time to time. From the properties visited about 300 specimens were collected which will be subjected to various physical and chemical tests with the object of ascertaining their durability, strength, and ease of dressing.

LIMESTONE.

In the Province of Ontario, limestone is obtained from a number of different geological formations. The stones from these formations are determinable by certain more or less fixed characteristics, which make a geological basis of classification the most easily understood.

The Beekmantown or Calciferous limestones, which are exposed over considerable areas eastward of Brockville, are of dark colour and liable to be marred by the presence of cavities. This stone may be recognized in buildings in eastern Ontario by the brown colour it assumes on weathering. It was formerly quarried to a large extent near Brockville and Prescott, for bridge and canal construction. Very few quarries are now in operation, and these are worked from time to time only, to fill the demands of local building.

Roughly speaking, the Chazy limestones form a ring which extends from the Ottawa to the St. Lawrence, in that part of the Province lying east of Ottawa. The stone is for the most part of a grey colour and has the property of retaining its tint on weathering. On the Ottawa, small operations have been conducted near L'Orignal, and more extensive work on a deposit of high-grade stone east of Hawkesbury. In the vicinity of Winchester are many small openings, worked intermittently only. Along the St. Lawrence the quarry on Sheek island near Mille Roches is the most important.

The Trenton and Black River limestones occupy the middle of the Chazy ring in the east of the Province, and occur as narrow strips in the Ottawa valley as far up as Pembroke. A broad belt of this rock also occurs between Georgian bay and Lake Ontario, forming the shore of the latter body of water from Kingston to Bowmanville. The stone when fresh quarried is light grey to dark bluish-grey in colour, and may be recognized in buildings by the fact that it assumes a much lighter colour on weathering, in some cases becoming almost white. The stone of these formations has been much used in the past for canal and bridge work as well as for ordinary building. Some of the largest quarries now in operation are in Black River or Trenton areas, more particularly at Ottawa, Point Ann, Kingston, Longford, and Tweed.

The Niagara limestones occur as a narrow belt from Queenston Heights to the Bruce peninsula: forming the brow of the Niagara escarpment which owes its existence to the presence of these hard limestones. Different types of stone occur, but they are all of a light colour, with a tendency to yellow rather than to grey tones. Great quantities of Niagara stone were formerly quarried for canal and bridge construction, at Beamsville, Thorold, and Queenston. Good building stone is now obtained at the two latter places as well as at Hamilton, Wiarton, and Owen Sound. Much crushed stone is made from Niagara rock, more particularly at Ancaster, Dundas, and Owen Sound (Clinton).

The Guelph rock occurs as a narrow lenticular patch west of the Niagara formation, stretching about 80 miles northward from Paris. The freshly quarried stone is always of a yellow or buff colour, but tends to a grey tint on weathering, and is highly magnesian in character. This stone was formerly largely employed for building in Guelph, Galt, Preston, Hespeler, Fergus, Elora, and Durham. Most of the present output of Galt, Guelph, Fergus, etc., is converted into crushed stone, but a little material for building is still produced at Guelph, and near Erin.

In the western peninsula of Ontario, the only formation productive of limestone is the Onondaga (Corniferous). The stone is of a light grey colour, and turns somewhat darker on weathering. The only important quarries now in operation are at St. Marys; but excellent building stone occurs in the Amherstburg quarries, which are, however, now being worked for other purposes. A large amount of material is being quarried at Port Colborne, and at Hagersville, but it is nearly all used for flux, road making, and in the manufacture of Portland cement. Very pure limestone for lime making, and for use in the chemical industries, is obtained near Beechville.

SANDSTONE.

In the eastern part of the Province, there occurs along the Rideau lakes, and in other small areas, a standstone of Potsdam, or in part Beekmantown (Calciferous) age. This material has been quarried from the vicinity of Brockville, to Perth and Smiths Falls. Some of the stone is white, other parts are spotted; and near Perth is a small deposit of purple banded stone. The only quarry now in operation is near Westport, where a heavy example of the stone is being obtained for canal construction. Farther north, in the township of Nepean, a white and yellow banded sandstone—the so-called Nepean stone—has been quarried for many years, and has been used in many structures in Ottawa; more particularly the Parliament buildings, and recently, the new Museum. The chief output of the quarries is paving blocks. The building stone is produced only when contracts are obtained.

The Medina sandstone—unquestionably the finest building stone that has been quarried to any extent in the Province—occurs at many places along the face of the Niagara escarpment, from Merritton to Orangeville. Three types of this stone may be recognized: a grey, a brown, and a mottled. The grey stone is still obtained in considerable quantity from Milton to Inglewood, and is largely used in Toronto. The brown stone, of which the Parliament buildings and numerous other structures in Toronto are built, was obtained from the Medina formation at the Forks of the Credit. These quarries are now all idle, as the increasing difficulty of production has made the cost of extraction too high for present economic conditions.

The Oriskany sandstone occurs only in the county of Haldimand, and is, throughout most of its extent, an inferior stone for building purposes. The best grade of stone is found north of Cayuga, but it is now being quarried on a very small scale at one point only.

CRYSTALLINE LIMESTONE.

The great Archæan or crystalline area, which occupies the central and northern part of the Province, is rich in bands of crystalline limestone, in Renfrew, Lanark, Haliburton, Hastings, Frontenac, etc. At a great many places a small amount of quarrying has been done, but no extensive operations have ever been conducted. The most important structure built of this stone is the post-office in Renfrew. Older buildings at Marmora, and at Lanark, show the stone to be durable, and of excellent appearance. The only quarries of any importance now in operation are those near Renfrew, which are worked more particularly for the making of lime.

MARBLE.

Many of the belts of crystalline limestone are sufficiently fine in grain to deserve the name of marble. Most of these marbles are not white, but are variegated in colour, many of them presenting a very attractive appearance when polished. Geological Survey reports contain numerous references to deposits of this kind at various points in the area. At the present time two companies are actively engaged in the production of marble, and with every chance of success. The Ontario Marble Company is operating near Bancroft on a marble belt which is

yielding a number of varieties of variegated stone of exceptional beauty. The North Lanark Marble Company is engaged in extensive operations to the eastward of Clyde Forks on the Kingston and Pembroke railway. The stone consists of a white or lavender coloured base with cloudings of buff or green serpentine.

DECORATIVE MATERIALS.

Of the decorative stones other than marble, there is no present production. The unique blue mineral sodalite, formerly obtained near Bancroft, is no longer quarried, although the deposit is by no means exhausted. Serpentines and iridescent feldspars are known to occur in the Archæan area, but, as there is no actual production, they do not properly come within the scope of the present report.

GRANITE.

The Archæan area contains many granitic masses, which will eventually be quarried for building and monumental purposes. Hitherto, very little attention has been directed to this class of stone in Ontario, particularly in the interior. At Kingston, quarrying operations were carried on many years ago, and small amounts were also obtained near Gananoque, and at Brockville. At the present time, the only quarries of importance are being worked north of Gananoque, more particularly for the making of paving blocks. A small amount of building and monumental stone is, however, produced.

GNEISS.

Gneiss has been quarried to a very small extent near North Bay and Gravenhurst. More recently a small quarry was opened near Parry Sound, which is still in operation.

While a considerable amount of fairly good building stone will continue to be produced from the different formations throughout the Province, I am of the opinion that, we must look to a development of the crystalline limestones, marbles, and granites, for a regeneration of the stone industry. Concrete is taking the place of stone for all heavy construction, and is rapidly replacing it for the cheaper types of building. With increase of wealth, the highest grades of stone are demanded for buildings of a monumental character. Most of our standstones and limestones fall short of this standard, but when more is known of the crystalline limestones and marbles they will be more largely employed for structures of the highest type.

In the erection of fine buildings in the cities, there is a growing tendency towards the use of granite, which is likewise replacing limestone for monument bases. Modern quarrying methods and machinery have largely reduced the difference in cost of quarrying and working granite, as compared with the softer stones. In consequence, we may confidently expect to see a steadily increasing demand for granite. This demand can not be met either by the quality or the

amount of granite at present produced in the Province. Is it not a reasonable assumption that some at least of the numerous deposits of granite in the Province will be able to supply the demands of the future?

It cannot be denied that there is a serious decline in the production of building stone. The chief causes for this decline, and the reasons for the present condition of the industry are tabulated below:—

(1) The use of cement for heavy construction, such as the building of bridges and canals.

(2) The use of cement blocks and artificial stone for architectural purposes.

(3) The cheap importation of Indiana limestone, and Ohio sandstone.

(4) The modern custom of erecting steel buildings, and facing them with terra-cotta, glazed brick, or artificial stone.

(5) The failure of the Medina brown stone.

(6) The increasing demand for granite, to which the Province has failed to respond.

(7) The high wages demanded by stone-cutters, and the difficulty of procuring a sufficient number of competent men.

(8) The fact that most of the stone quarries are in the hands of very small operators, who work them only on receiving an order. In consequence, there is always a delay in delivery, and stone of a mixed character is shipped. These same owners do not devote their time to the stone business: it is merely incidental, hence receives little attention. If there were more strong companies actively and aggressively carrying on stone quarrying as a business, the cost of stone would be reduced, and the use of concrete, for architectural purposes, restricted.

ON THE INVESTIGATION OF THE PEAT BOGS OF CANADA, AND MANUFACTURE OF PEAT FUEL AT THE GOVERNMENT PEAT PLANT, ALFRED, ONT.

A. Anrep, Jr.

Early in the season of 1910—in accordance with instructions—I started the peat plant at Alfred, Prescott county, Ontario, in full working order; and when, upon the advent of autumn, manufacturing and general operations ceased, I commenced and completed a thorough investigation of the Holland peat bog, situated in West and East Gwillimburg and King townships, Simcoe and York counties, near Bradford, Ont. The total area covered by the bog is approximately 14,641 acres; varying in depth from 5′-0″ to 20′-0″. It is estimated that this bog contains 61,641,981 cubic yards of raw peat, capable of producing, say, 9,631,552 tons of peat fuel, with 25 per cent moisture.

The bog is well situated as regards freight facilities and market: being only 42 miles from Toronto. The Grand Trunk railway crosses the middle of the bog, and the Canadian Pacific railway passes on the south side of the bog.

Inasmuch as a systematic investigation of a peat bog occupies considerable time, and as I was without an assistant, it was found impossible to investigate more than one bog during the season of 1910.

ALFRED PEAT BOG.

Part of May, the months of June, July, August, September, and part of October, were spent at Alfred, superintending the operations of the peat plant, where peat was made during a period of 50 days.

SALE OF PEAT IN OTTAWA.

The peat sold to private parties in Ottawa proved to be an excellent fuel; indeed so satisfactory, that those who used the peat not only expressed their satisfaction by letter, but have applied for further supplies for next season.

The following tonnage was distributed:—

24	tons,	900	lbs.	sold to Public Works Department.
441	"	400	"	" by C. C. Ray Company for domestic use.
61	"	1,424	"	" by Mines Branch for domestic use,
160	"			" by Mines Branch (to Fuel Testing Plant),
98	"	1,000		" at the bog,
9	"			" by Mines Branch to Germany.
794	tons,	1,724	lbs.	

DEVELOPMENT.

While the plant was in operation, the following development work was carried on:—

(1) Continuation of necessary drainage of Alfred peat bog, not accomplished during the season of 1909.

Four open ditches, each 1,000 feet long, 2 feet wide at the top, and 1′-4″ at the bottom, by 3 feet deep = 741 cubic yards.

(2) Levelling the surface of bog. Two-thirds—about 47 acres of the ground—have been levelled and cleared from trees, trunks, and brush.

(3) Buildings: peat shed for storage of dried peat, 200 feet long, 22 feet wide, and 18 feet high, with platform for loading the peat into railway cars.

(4) Railway siding 500 feet long.

REPORT ON TESTS OF BLAUGAS.

Edgar Stansfield, M.Sc.

Tests made on gas from a cylinder supplied by Mr. James Ogilvie of the Railway Commission.

EXPLOSIVES LIMITS.

Lower Limit.—It was found that a mixture of gas and air containing 5·2 per cent of the gas *did not* explode, whilst one containing 5·5 per cent *did* explode.

Upper Limit.—A mixture of gas and air containing 10·6 per cent of the gas *did not* explode, whilst one containing 10·1 per cent *did* explode.

The limits of explosibility are, therefore, between about 5·4 per cent and 10·4 per cent of the gas with air; that is, a range of 5·0 per cent.

The explosive limits of any gas vary markedly—according to the apparatus used for testing. The apparatus used in the above experiments consisted of a stout glass tube of approximately $\frac{3}{4}''$ inside diameter. The gases were fired by means of a strong electric spark passing between two platinum points, about $\frac{1}{16}''$ apart, and placed at one end of the tube. The gases were enclosed over mercury, and the pressure adjusted to atmospheric pressure before firing.

In order to compare this apparatus with the apparatus used by other experimenters, the limits of explosibility of hydrogen were determined in exactly the same way as with Blaugas.

Lower Limit.—8·9 per cent of hydrogen *did not* explode, whilst 9·7 per cent *did* explode.

Upper Limit.—66·4 per cent *did not* explode, whilst 66·0 per cent *did*.

The range of hydrogen is, therefore, between about 9·3 per cent and 66·2 per cent, that is, a range of 56·9 per cent.

Table of Explosive Limits of Gases with Air.

Results obtained by Edgar Stansfield:—

	Lower Limit.	Upper Limit.	Range.
	% of gas.	% of gas.	
Hydrogen	9·3	66·2	57
Blaugas	5·4	10·4	5

Results quoted in Travers' "Study of Gases" (1901):—

	Lower Limit.	Upper Limit.	Range.
	% of gas.	% of gas.	
Acetylene	3	82	79
Hydrogen	5	72	67
Carbon monoxide	13	75	62
Ethylene	4	22	18
Methane	5	13	8

Judging from the range of explosibility, Blaugas is an unusually safe gas; but although this is the criterion by which a gas is often judged, a low, lower limit must constitute a grave danger in cases of leaks of the gas into the air of a room. Blaugas has a distinctly low, lower limit. On the other hand, it should be stated that, with no mixture of the gas with air was there at all a violent explosion; the explosion wave travelling slowly and quietly down the tube, as a visible flame. A larger volume of air and gas would doubtless have given a more distinct explosion; but there was a marked difference from the sharp crack obtained with suitable mixtures of air and hydrogen in the same apparatus.

Blaugas has a distinct and characteristic, though not unpleasant, smell; this is an advantage, as with reasonable care leaks of the gas in a room should be detected before enough escaped to form an explosive mixture.

ANALYSIS OF GAS.

A complete analysis of Blaugas would be an extremely difficult matter, as it is evidently a very complex mixture, and the result would be of no practical value.

The normal method for gas analysis consists in treating the gas with a succession of reagents, and determining the volume of gas absorbed by each reagent. The reagents used in analysing the Blaugas were as follows: (1) caustic potash for absorbing carbon dioxide; (2) an alkaline solution of pyrogallic acid, or yellow phosphorus, for absorbing oxygen; (3) a solution of bromine in potassium bromide solution, or fuming sulphuric acid containing 15 per cent sulphur trioxide, for absorbing unsaturated hydrocarbons; and (4) an ammoniacal, or acid, solution of cuprous chloride for absorbing carbon monoxide: the unabsorbed gases consisting of hydrogen, nitrogen, and saturated hydrocarbons, such as methane, etc.

It is claimed for Blaugas that it is non-asphyxiating and non-poisonous. As it contains only a trace of oxygen, the first claim is obviously incorrect; carbon monoxide is the only poisonous gas to be expected, so that the accuracy of the second claim appears to turn on its absence or presence.

Ethylene is the simplest unsaturated hydrocarbon, and is easily removed by bromine or fuming sulphuric acid. The more complex unsaturated hydrocarbons—especially those of the aromatic series—are more difficult to remove, and traces left unremoved are liable to be absorbed by the cuprous chloride solution, and thus appear to be carbon monoxide. As Blaugas is very rich in unsaturated

hydrocarbons, some of which are very difficult to remove, the exact determination of carbon monoxide is not easy. Six experiments, in a Randall and Barnhart gas analysis apparatus in which water is the confining liquid, and using bromine to absorb ethylene, etc., gave a mean of 0·92 per cent carbon monoxide. Two experiments in a Bone and Wheeler apparatus—where mercury is used instead of water—using bromine as absorbent as before, gave a mean of 1·04 per cent carbon monoxide; and three experiments in the same apparatus—using fuming sulphuric acid as absorbent—gave a mean of 1·30 per cent.

As a check on the above, a slow stream of the gas was passed through the following purifying train: one wash bottle containing bromine in potassium bromide solution; one wash bottle of alcohol; two U tubes of fuming sulphuric acid; one wash bottle of caustic potash solution, and one U tube with solid caustic potash; the purified gas being collected over mercury and the stream being so slow that not more than 20 c.c an hour passed through. This would appear to be certainly sufficient to remove all carbon dioxide and unsaturated hydrocarbons, and would be liable to remove some carbon monoxide. The resultant gas analysed in the Bone & Wheeler apparatus was shown to be practically free from unsaturated hydrocarbons, but to contain, as a mean of four experiments, 0·24 per cent of carbon monoxide.

Blaugas, when shaken up with a dilute blood solution, gave it a distinct rose tint, and with a stronger blood solution it caused the precipitate, produced by the addition of tannin, to be distinctly redder than that produced from normal blood in the same way. Both the above are characteristic qualitative tests for carbon monoxide.

From the above tests it appears certain that carbon monoxide was present in the sample of Blaugas supplied, and to an extent of not less than one-fourth of one per cent, nor more than one per cent; the lower figure being the more probable.

Carbon monoxide is an extremely poisonous gas, but as Blaugas contains such a small percentage of it the risk from poisoning due to leaks of the gas is negligibly small. A sample of Montreal city gas was found to contain nearly 15 per cent of carbon monoxide. The smell of Blaugas, as already mentioned, adds to its safety. From time to time the gas was allowed to escape into the laboratory, in amounts sufficient to give a very distinct smell, but no ill effects were observed by those in the room.

As Blaugas is liquified in the supply cylinders, it is probable that the composition of the gas will change as the cylinder is emptied, also that at any time the composition of the gas will be different according to the rate at which it is tapped off. This point was not carefully examined, but no marked changes were observed.

RESULT OF ANALYSIS.

	Per cent
Carbon dioxide	0·3
Unsaturated hydrocarbons	53·9
Oxygen	0·4
Carbon monoxide	0·3
Hydrogen, nitrogen, methane, etc	45·1

REPORT ON THE EXPLOSIVES INDUSTRY IN THE DOMINION OF CANADA.

Captain Arthur Desborough, H. M. Inspector of Explosives.

OTTAWA, October 1, 1910.

TO DR. EUGENE HAANEL,
Director of Mines, Ottawa.

SIR:—I have the honour to submit the following report on my investigation of the explosives industry in the Dominion of Canada.

Before offering any criticisms or recommendations, I propose to state briefly the more important principles upon which the British regulations are based; these general principles being, in many cases, equally applicable to the regulation of the industry in the Dominion.

(1) *Authorization of Explosives.*—No explosive may be manufactured in or imported into the United Kingdom for sale until it has been subjected to examination by the chemical advisers of the Explosives Department. It is the duty of these gentlemen to satisfy themselves that the explosive is not unduly sensitive to friction or percussion, and that it also possesses a reasonable degree of chemical stability. Explosives which are found to be of the requisite standard are included in the list of authorized explosives as soon as a license is obtained to allow of their being manufactured or imported.

(2) *Manufacture of Explosives.*—No explosives may be manufactured except in an authorized place. A person, therefore, who wishes to manufacture explosives has to obtain a license. By the terms of his license he is only permitted to erect buildings of a specified construction, on the sites shown on a plan attached to his license. The maximum number of work-persons, and the maximum quantity of explosives allowed to be present in each building are specified, as is also the nature of the operations proposed to be carried on in the buildings. The factory buildings are required to be at certain distances from one another, and certain distances must also be observed from buildings and works outside the factory. The distances are determined by the quantity of explosives allowed to be present in the building. A table showing quantities of explosives and distances was drawn up some years ago from data obtained by noting the damage caused by explosions of known quantities of explosive; suitable interpolations were made to render the application of the table practical. Since the adoption of this system of distances, no member of the general public has been killed, and no dwelling house has sustained any serious structural damage by an explosion in any factory. From recent explosions it appears that the distances are hardly adequate where the explosive involved consists of nitro-glycerine unmixed with other ingredients.

Generally speaking, the buildings in which operations of manufacture are carried out are required to be of light construction, having close joined wooden floors and being lined with wood or other suitable material. I will refer to magazine construction under the head of storage.

No responsibility is taken by the Explosives Department regarding the machinery employed, but in the event of any particular type of machine proving to be dangerous, the question of its discontinuance is taken up with the occupier of the factory.

The maximum number of work people allowed to be present in a building is determined by the nature of the operations carried out in the particular building, and, as a rule, varies from two to six. This number is exclusive of the men employed to convey explosives or ingredients to or from the building and who are essentially non-producers.

I may add that the death rate among the employes has been for a considerable number of years well below 1 per 1,000.

Storage of Explosives.—Magazine licenses are issued by the Home Office for the storage of explosives. As in the case of factory licenses, the terms require that the building should maintain certain distances from the buildings and works depending on the quantity of explosives allowed to be kept. Only half the specified distance need be maintained if the building is screened by substantial earth banks, and if satisfactory screening is afforded by the natural features of the ground the distances are sometimes diminished by 75 per cent. Magazines are almost invariably constructed of substantial masonry or brickwork, as it is considered that if the explosive is of good quality the only dangers to be feared are those which will arise from outside the building. The only objection to this form of construction is, that should an explosion occur in a building not surrounded by earth banks considerable damage may be caused by the projection of heavy debris. In the past thirty years, three magazines have been destroyed by explosions and in no case were any lives lost or surrounding property seriously damaged.

Licenses for the storage of limited quantities (2 tons of gunpowder or 1 ton of high explosive) are granted by the local authorities, if specified conditions as to construction and distances are observed.

Home Office Licenses.—Both factory and magazine licenses are prepared in draft by the applicant in consultation with the Explosives Department. When the draft has been agreed upon, the applicant is given permission by the Secretary of State to lay the draft before the local authority, in whose jurisdiction the proposed buildings are situated, in order to receive their assent. If the local authority give their assent, the draft license is confirmed. If, however, they refuse their assent, an inquiry is held by an officer of the Explosives Department, and the Secretary of State, on receipt of the report, either upholds the local authority or inserts additional terms to cover their objections, or over-rides their decision.

Transportation.—Accidents in transportation are practically unknown and this may be fairly ascribed to the quality of the explosives, the specified method of packing, and the care in handling the traffic. The method of packing and general regulations as to transportation are prescribed in Orders of Secretary of State made under the Act. Railway companies, canal companies, and harbour

authorities have, however, to make by-laws regarding the transportation, loading, and unloading of explosives. These by-laws have to receive the sanction of the Board of Trade before they are operative.

Importation.—Only authorized explosives may be imported for sale. A person desiring to import explosives has to obtain an importation license from the Home Office. Before a license is granted he is required to show that he has an authorized place of storage at his disposal. Generally the importer owns licensed magazines, but if not he obtains a certificate from an occupier of a licensed magazine, that sufficient storage accommodation is available for the importation. When the importation is effected, the customs officers take samples which are forwarded for examination and the explosive is deposited in the specified magazines. If the samples are reported on as coming up to the required standard, the explosive is placed at the disposal of the importer. Otherwise, further samples are obtained (if the importer so desires), or the explosive is definitely condemned as being unfit for distribution. In certain doubtful cases the explosive is released, on the importer guaranteeing that it will all be used up in a limited time.

Use of Explosives.—The use of explosives is not governed by the Explosives Act. The use in mines and quarries is regulated by general rules contained in the Mines and Quarries Acts, and by special rules made under those Acts. A Bill was introduced into Parliament last year giving the Secretary of State power to make regulations regarding the use of explosives in construction works, but, owing to the large amount of other legislation before the House, the Bill was dropped.

Home Office Testing Station.—The station was established in 1897 under a section of the Coal Mines Regulation Act, 1896, and the work carried on there must not be confused with the purely chemical work of the chemical advisers of the Explosives Department. The station is used for testing explosives for use in coal mines where danger is to be feared from fire-damp, or coal dust. The test consists in firing charges from a cannon into a chamber filled with an explosive atmosphere of air and coal gas. The details of the test are about to be considerably modified and for this purpose a new apparatus is being erected in the north of England. Only authorized explosives may be submitted to the test and the names of those which have passed this test and the conditions under which they may be used are published from time to time in an Order of the Secretary of State. These explosives are known as Permitted Explosives.

Explosives Industry in the Dominion.

I have had the opportunity of visiting the majority of the more important factories. As was to be expected, the standard of precautionary measures against accidents varied considerably. Any criticism I may make must not be considered as being directed against any particular factory, as I purposely avoided making a detailed inspection of any one plant, feeling that with the very limited time at my disposal, the utmost I could do would be to obtain a general impression as to the conditions under which explosives were manufactured.

As regards the quality of the explosives, I will defer comment until I discuss the question of use, as the only information I have obtained was gained in course of conversation with the users of explosives.

Most of the factories appear to suffer from the defect of having been started in a small way and then added to as business expanded. Had the probability of expansion been recognized at the commencement, there is little doubt but that the buildings would have been placed in more suitable positions and overcrowding thus avoided. In some instances the quantities in the buildings were considerably greater than the distances from other buildings would allow. This was sometimes due to the fact that explosive which had been operated on was allowed to remain in a building while a second batch was being operated on and a third was being brought into the building. As a general principle, a batch of explosives should be removed from a building as soon as it has been operated on; if the building in which the next operation is to take place is not available, it should be placed in an expense magazine situated at a suitable distance. The chief danger of explosion must of necessity be with the explosive which is being operated on; it is, therefore, unwise, to say the least of it, to expose a second or third batch to the certainty of communicated explosion. In other cases the excessive quantities were due to overcrowding of the factory buildings.

The actual operations of manufacturing nitro-glycerine appear to be generally carried out in one building, owing to climatic conditions, and this entails the accumulation of large quantities, sometimes amounting to over five tons, in one building. The majority of the factories have only one nitrating plant, and I think manufacturers should consider whether it would not be advisable to install a second plant, which could be used alternatively, and thus prevent such large accumulations in one building. An explosion in a nitrating plant must put a factory out of action for some considerable time, unless there is a duplicate plant available.

In some factories there were too many cartridge packing machines in one building. The objection to this practice does not lie in the number of machines but in the large number of men who must be present in the buildings to attend to the machines. In one instance, all the machines in the factory were under one roof, and no less than 15 men were present. Apart from humanitarian objections to the exposing of so many lives to one risk, I am strongly of opinion that it is economically unwise to concentrate all the cartridge packing in one building. I understand that in one factory last year 11 lives were lost, due to explosions which occurred in the packing house. This number exceeds the annual average number of deaths in all the explosives factories in Great Britain. Generally speaking, there appears to be a tendency to allow unnecessary articles to accumulate in danger buildings. The object of the manufacturer should be to reduce the number of movable implements to the minimum. When it is remembered that a thin layer of most explosives can be exploded by a blow from a comparatively light weight falling a distance of a few feet, the importance of this point will be realized. I may mention in this connexion that I have more than once witnessed the experiment of a thin layer of gunpowder spread on a wooden floor being ignited by a glancing blow from a wooden broom stick.

The presence of iron hammers and other tools is also objectionable. When they are required, they should only be used by a responsible person and should be removed as soon as they are no longer wanted.

Greater care should be exercised to prevent grit getting into the explosive and also to prevent explosive from lodging in crevices in the walls and floors of buildings. The iron framework of machines should be painted to prevent the detachment of rust, which is otherwise almost certain to find its way into the explosive.

I do not think that manufacturers pay sufficient attention to details, and it is only by studying details that it is possible to make the manufacture of explosives relatively safe. Apart from the risk of spontaneous decomposition, which may arise on rare occasions during the manufacture of nitro-glycerine, there is the risk of spontaneous decomposition from explosive dust settling on heating pipes and being left there, and from accumulations of explosive in cracks and crevices. With reasonable precaution these latter risks should be practically non-existent. The heating pipes should be so placed that they are readily accessible to inspection and the walls should be lined with a suitable material; the floor, if not close joined, should also be covered. I understand that rubberoid has been employed both as a lining for the walls and a floor covering by several manufacturers with excellent results.

Another risk to be guarded against is the ignition of a thin film of explosive by a blow. As I have already stated, as few movable articles as possible should be present in a building. When it is remembered that most explosives when heated are much more sensitive to friction or percussion, special precautions should be taken in drying houses to eliminate this risk, and I think that the explosive should be allowed to cool down to the normal temperature before it is handled or the drying racks removed.

Grit mixed with explosive renders it far more sensitive; precautions should, therefore, be taken to prevent its introduction either by the work persons themselves, or by its adhering to boxes and packages brought into the building. It is impossible to prevent a certain amount of grit entering a building, and this grit will, of necessity, be mostly present on the floors of the buildings; it is important, therefore, to minimize the quantity of explosive spilt on the floor and also to have the floors swept periodically.

In buildings in which explosion is likely to be preceded by fire it is especially necessary to provide adequate means of escape for the work people, and care should be taken that the exits are not blocked by boxes or packages.

Sufficient forethought does not seem to be paid to the wiring of the electric light system. Apart from the dangers of ordinary wear and tear, there is always the risk that the concussion caused by an explosion in a neighbouring building may so dislocate the wiring as to cause a fire.

Storage of Explosives.

I have not had the opportunity of visiting many magazines. In most instances the distances maintained from other buildings were inadequate, owing to the large quantities stored. I cannot help thinking that it would be wiser to erect a greater number of buildings and to store in each smaller quantities of from 25 to 50 tons.

In some instances I found packages of damaged explosive which had been returned by the users. Damaged explosive should be destroyed, as, if left in a magazine, it is liable to be overlooked and if of the nitro-compound class may ignite spontaneously.

Transportation of Explosives.

My attention was drawn to two instances of the transportation of explosives by water, which I think are deserving of comment. In one case, after over 100 tons of dynamite had been loaded into a vessel, a number of cans of gasoline were placed on top of the explosive. Highly inflammable and volatile liquids, such as gasoline, should not be transported with explosive. In another instance, cargoes of explosive were habitually conveyed in a gasoline launch. I do not think it can be claimed that gasoline launches have reached such a state of perfection that the possibility of fire can even be regarded as remote. If such a launch caught fire in a crowded harbour, the result would be disastrous.

Use of Explosives.

In the course of conversation with the users of explosives I have frequently been told that the quality of the explosives manufactured in the Dominion leaves much to be desired. It was asserted that no two charges fired in similar circumstances would do the same amount of work. Except so far as shot firing in coal mines is concerned, I do not think this unevenness of explosive can be said to be a positive danger, apart from the production of an unnecessarily large volume of deleterious gases from an overcharged shot. In the case of coal mines, where there is risk of igniting gas or dust, the danger is very appreciable. A miner will always gauge the weight of his charge by the weakest shot he has fired and the tendency will always be to overcharge. The gases produced from the surplus of explosive not having any work to do will not cool down rapidly, and should they come in contact with fire-damp or coal dust in suspension would probably cause an ignition. It is imperative, therefore, that steps should be taken to ensure an even quality of explosive for use in coal mines.

A thin film of explosive on the exterior of a cartridge, a state of affairs which I frequently noticed in the buildings in which cartridges were being packed into boxes, can hardly be conducive to safety in ramming. In the absence of specific information as to the accidents which occur from the use of explosives, I do not feel that it is possible for me to offer any further comments.

It will not be out of place, however, to give a word of warning as to the misleading effects of demonstrations of the safety of explosives. These experiments generally consist in burning a cartridge in the open or throwing a small quantity on to a fire. Such experiments can generally be performed with blasting explosives without risk. The behaviour of the explosive when confined in a bore hole or when ignited in bulk so that a certain amount of pressure is generated would be a much more reasonable test; but such experiments would not suit the demonstrator as they would be much more likely to result in an explosion. I may instance the case of many of the ammonium nitrate explosives, which are very difficult to ignite in

the open, and when thrown on a red hot sheet of iron merely melt, but which in the confinement of a shot hole have been found, under certain conditions, to burn fairly readily until sufficient pressure is set up to cause the unburnt portion to explode.

It cannot be pressed too strongly upon the user of explosives that the function of an explosive is to explode, and that, no matter what assertions are made by an interested person as to the safety of his explosive, all explosives should be regarded as dangerous.

Recommendations.

In the following pages I have acted on the assumption that the Dominion Government has the power to legislate on these matters.

It is not possible for me to mention in detail all the points which I think should be included in the draft bill which is in course of preparation. I propose, therefore, under the above heading to discuss shortly some of the more important provisions which should be included in the proposed legislation and also to offer some suggestions on matters which, though they do not come directly within the scope of the bill, are of sufficient importance to warrant my commenting on them.

The following are the essential points which I propose to discuss:—

1. Authorization of explosives.
2. Licensing of factories.
3. Control of storage not otherwise provided for.
4. Control of transportation not otherwise provided for.
5. Control of importation.
6. Inspection and sampling.
7. Establishment of chemical laboratory and testing station.
8. Investigation of accidents in factories.
9. Investigation of accidents in storage, transportation, and use.
10. Appointment of staff.

(1) *Authorization of Explosives.*—I think the system in Great Britain should be adopted. It will undoubtedly improve the quality of the explosives manufactured in the Dominion and should thereby have a tendency to diminish accidents in use; it must not be expected, however, that fool-proof explosives will ever be produced. It will also prevent the user being at the mercy of the enthusiastic inventor who persuades him to try a new explosive which has probably been invented many years previously and then discarded on account of its danger or unsuitability.

(2) *Licensing of Factories.*—Factories should be licensed on the principle of limiting the amount of explosive allowed to be present in a building, in accordance with the distances that the building can maintain from the other buildings in the factory, and buildings and works outside the factory. Limitations should also be assigned as to types of construction adopted, the number of work persons allowed to be present, and the nature of the operations to be carried on in the various buildings. If these points are enforced in a reasonable manner, I do not think that manufacturers will find their trade unduly hampered.

As regards existing factories, I do not think the occupiers should be required to immediately conform to the new system, but that a definite time limit should be assigned, so as to admit of the change being made gradually. If, however, there happen to be particular buildings in a factory, which constitute a very definite menace to the public safety by reason of their proximity to a city, I think the occupier should be required either to remove the building forthwith, or to reduce the quantity of explosive in the building, so as to diminish the danger zone. It is not possible to lay down a hard and fast rule and each case should be considered separately and treated on its merits.

(3) *Control of Storage.*—The special points to which attention should be paid are the situation, quantity of explosive, and construction. The first and second should be governed by the table of distances. As regards the third, two somewhat antagonistic features have to be considered. First, the building should be protected from dangers from without, such as rifle bullets, and should have security against unlawful entry and fire. Second, in the event of an explosion occurring the projection of heavy debris should be minimized; this feature is probably of greater importance in the Dominion than it is in Great Britain, owing to the fact of the large number of frame dwelling houses which are to be found here, whilst they are almost non-existent in the latter country.

The ideal construction for a magazine would be to have a relatively lightly constructed building, surrounded by substantial earth banks; but it is difficult to make this type reasonably secure against unlawful entry and other dangers from without. It must always be remembered, however, that with the system of the authorization of explosives there should be little risk of the explosive igniting spontaneously, and as no operation should be carried on in a magazine the principal danger of explosion comes from causes outside the building. The results of some experiments carried out in Germany were recently published and the conclusion arrived at by the experimenters was, that a certain type of reinforced concrete gave the best result. It was found that with the particular form of construction very little debris was projected when an explosion occurred in the building, as the concrete was so pulverized that the fragments did not carry any great distance. If funds are available, it would be of considerable value to have experiments carried out on similar lines with buildings constructed to suit Canadian requirements.

In Great Britain there is a statutory requirement that every magazine should be fitted with an efficient lightning conductor; there are, however, no suggestions given as to what constitutes such a conductor. As I understand that parts of this country are frequently visited by severe electrical storms, I think the question of protecting magazines from lightning should be considered. I would venture to suggest that the scientific staff of some of the Universities and representatives of the explosives manufacturers should be invited to co-operate with your Department to inquire into the most efficient and economical system of securing the necessary protection. There is a system of storage in Great Britain, which I have not met with in the Dominion, but which might be found of use where the climatic conditions will admit of it. In the rivers Thames and Mersey vessels are moored at places specially selected by the Harbour Authorities, and these vessels are licensed by the Home Office as Magazines. Where there is a considerable water-borne trade, the use of such vessels as distributing centres might prove of advantage.

(4) *Control of Transportation.*—The control of transportation by rail is in the hands of the Railway Commissioners, and the only way in which the proposed legislation will affect this method of transportation will be as regards the quality of the explosive conveyed. I understand that the regulations adopted by the Commissioners are those promulgated by Col. Dunne's bureau in New York. The great value of these regulations has been amply proved; but being a private concern there are not the same facilities for maintaining the standards of quality of the explosives as will be the case when the authorization of explosives is in the hands of the Government.

I understand that at present it is practically impossible to transport legally small quantities of explosive by rail. It is generally certain that this traffic is carried on, probably in passenger trains, and with detonators and blasting explosive packed together. I would venture to suggest, therefore, that your Department should approach the Railway Commissioners, with a view to discussing the question of recognizing and controlling the transportation of small quantities. I may mention that in Great Britain the railway companies have agreed to transport small quantities of explosive in cars loaded with other freight, when packed in a special manner.

As regards transportation by water or road, I think power should be included in the bill to regulate generally the method of stowage, the method of packing, the limiting of the nature of freight which may be transported with explosives, and the limiting the quantity of explosive transported at any one time, according to the nature of the vessel or vehicle in which the transportation is being effected.

(5) *Importation.*—Before any explosive is imported into the Dominion for sale or use, a sample should be submitted for authorization. The terms of the license for subsequent importations should require the importer to have at his disposal a licensed place of storage, in which the explosive would be detained until the chemical department have satisfied themselves by examination of the samples taken by the Customs that the explosive is of the requisite standard.

(6) *Inspection and Sampling.*—I need only remark that when a factory or magazine has been licensed it is necessary that they should be periodically inspected, to ascertain that the terms of the licenses are being complied with. Similarly, it is essential that after an explosive has once been authorized, samples should be periodically examined to see that the manufacturer is maintaining the required standard. Most explosives deteriorate in quality and chemical stability after prolonged storage. It is necessary, therefore, to obtain samples not only from factories and distributing magazines, but also from magazines in the occupation of the users of explosives. I have reason to believe that the Provincial authorities will be glad to co-operate with your Department in this respect.

(7) *Establishment of Testing Station.*—Apart from the chemical laboratory, which will be in the hands of the chemical advisers of the explosives department, it will be necessary to establish a station for the testing of explosives for use in coal mines. I understand that it is also considered desirable to erect an apparatus for testing types of safety lamps. I would suggest, however, that before deciding on the final details of the tests it would be well to await the conclusion of the experiments which are shortly to be carried out in Great Britain. It may be of interest to state that the Home Government have not contemplated instituting an

official test for the so-called rescue apparatus. The word 'rescue' appears to give the general public the idea that after an explosion has occurred in a coal mine it is only necessary for men wearing these breathing apparatus to enter the mine, to enable them to rescue the unfortunate miners who have been exposed to the effects of the explosion and the deadly effect of after damp. I think the more reasonable view to hold as regards the practical utility of breathing apparatus is that their chief scope lies in the direction of coping with fires below ground in the early stages, and it is only in the sense of preventing the spread of a fire which would endanger the lives of those present in the mine that the term 'rescue' can be applied to them.

Apparatus should be installed at the testing station to enable comparisons to be made between the kinetic energy of different natures of explosives and also to determine the velocity of detonation of explosives. Information on these two points should prove of value to the users of explosives, to enable them to select the explosive most suitable for the work which they are undertaking.

(8) *Accidents in Explosives Factories.*—It is of the utmost importance that the explosives department should have full information regarding all accidents which occur in factories either by fire or explosion, even when no personal injuries are sustained. It is often from an accident in which no persons are injured that the most valuable information can be derived. I think that it should be obligatory for the occupiers of factories to report as soon as possible all such accidents, and to leave things untouched as far as is practicable, in case it should be deemed advisable to have the circumstances of the accident investigated by an official of the department.

(9) *Accidents in Storage, Transportation, and Use.*—Accidents which occur by fire or explosion in the storage and transportation of explosives should also be brought to the notice of the department; in those cases in which the storage or transportation comes under the control of the new Act, it may be desirable to have an inquiry held by an official of the department. In other cases, the co-operation of the Provincial Governments and the Railway Commissioners should be sought, in order to obtain as complete a record as possible of such accidents. Doubtless, the Provincial Inspectors of mines will be willing to inform the new department of the results of their investigations. As regards accidents in transportation by rail, the services of an inspector of explosives should be placed at the disposal of the Railway Commissioners, should they so desire it, to assist in carrying out investigations.

By far the larger number of accidents which occur with explosives arise from their use; it is of the utmost importance that all accidents occurring when the explosives are in use should be thoroughly investigated and classified. I have reason to believe that the Provincial Inspectors of Mines will be willing to co-operate with the department by forwarding accounts of accidents occurring in the mines under their jurisdiction. I understand, however, that a large number of accidents occur in works where there is no legislation affecting the use of explosives. I think it would be advisable for the Minister of Mines to take power in the proposed bill to frame rules to regulate the storage and use of explosives in such works, to require the reporting of accidents, and to have investigations made when such a course appears necessary.

It may be of interest to summarize the causes of the more frequently occurring accidents which arise from the use of explosives in mines, quarries, and construction works in Great Britain.

1. *Prematures.*—Often due to the use of short or bad fuse, or the use of straws and squibs to ignite the charge. May arise from a man attempting to light too many shots and thus being unable to take cover.

2. *Hang-fires.*—Often due to irregular fuse, or the ignition of explosive, which burns until sufficient pressure is set up to cause it to explode; this may be due to inferior quality of explosive or a weak detonator. Sometimes due to miscounting shots and returning too soon.

3. *Electrical Prematures.*—Generally due to the shot firer allowing another man to connect the detonator leads to the firing cable, which has been previously attached to the battery.

4. *Ramming.*—Due to frozen nitro-glycerine explosive, broken cartridge leaving a thin film of explosive in the bore hole. Cartridge sticking in the bore hole and being violently forced home. It is of the utmost importance that no explosive which is unduly sensitive to friction or percussion should be authorized for use.

5. *Striking Unexploded Charge when Removing Debris.*—Generally due to frozen nitro-glycerine explosive, or to weak detonator which fails to cause propagation of detonation through all the cartridges, or to the cartridges becoming separated by a layer of dirt in the shot hole.

6. *Boring into a Missed Shot.*

7. *Tampering with a Missed Shot.*

8. *Not Taking Proper Cover.*—In the case of electrical firing generally due to use of too short a cable.

9. *Fumes.*—Either due to defective ventilation, men returning too soon, or ignition instead of detonation of high explosive. The gases evolved by burning nitro-glycerine explosives are very poisonous. The burning may be originated by weak detonator or inferior quality of explosive.

10. *Preparing Charges.*—Generally dûe to frozen nitro-glycerine explosive, unduly sensitive explosive, recklessness, or lack of skill.

11. *Ignition of Explosive by Spark.*—Principally confined to gunpowder, where open lights are used below ground.

12. *Socketting or Springing.*—Due to re-charging before sufficient time has elapsed.

13. *Ignition of Fire-damp or Coal Dust*—Apart from the quality of the explosive, generally due to the firing of two shots, one after the other, without examining for gas after firing the first shot. The firing of overcharged shots is perhaps the more usual cause.

It may be of interest to state that during 1909 over 30 million pounds of blasting explosives were used in mines, quarries, and construction works in Great Britain, and that (exclusive of fatalities from explosions of fire-damp or coal dust) 53 lives were lost thereby.

Staff of the Explosives Department.—The technical staff of the new department should, I think, consist of a Chief Inspector, two Inspectors, and a Chemist. I cannot state too emphatically that the Chief Inspector should have sufficient

technical knowledge not only to enable him to administer what must of necessity be a very technical act, but also to deserve the confidence of the explosives manufacturers. As men possessing such qualifications are rare, I would venture to suggest that it would be very unwise to attempt to economize by offering an inadequate salary. As regards the two inspectors, it will hardly be possible to obtain the services of technically qualified gentlemen, and I think it would be sufficient if these gentlemen possessed practical experience of the use of explosives, one of them at least having gained his experience in coal mining. In assigning their salaries, the fact that their work must of necessity be somewhat hazardous should not be lost sight of.

The responsibility of the chemical adviser to the department will be considerable, as in his hands will rest the recommendation for the acceptance or rejection of explosives. When it is remembered that the authorization of an explosive or otherwise, or the condemnation of a batch of explosive which has been issued from a factory may involve large financial interests, it is hardly necessary for me to point out that this gentleman should be possessed of the highest technical qualifications and integrity. The salary of the chemical advisers of the Home Office is entirely dependent on fees; but it would be far preferable if the chemist of the new department were paid an adequate salary so that his whole time should be at the disposal of the government.

It will be necessary to employ a mechanic at the Testing Station, who will be competent to carry out minor repairs to the apparatus, and who would assist in carrying out official tests and experiments. He should also be responsible for the care of explosives stored in the magazine and for apparatus and stores used in connexion with the Testing Station.

I have the authority of Major Cooper Key, His Majesty's Inspector of Explosives, for stating that he will be glad to afford facilities for any person who may be appointed as an Inspector to be attached to the Explosives Department of the Home Office, to enable him to get an insight into the administration of the Explosives Act, and the methods adopted for the testing of explosives for use in coal mines. Major Cooper Key also states that he would be glad to make arrangements for the chemical adviser of the new department to work in the laboratory of Messrs. Dupré, who are the chemical advisers of the explosives department. I would strongly urge that these facilities be taken advantage of.

If my proposal as to the regulation of the use of explosives be adopted, I would suggest that two or three gentlemen be appointed as assistant inpectors, whose duty would be confined to the administering of these regulations. Their principal functions would be to endeavour to educate the users of explosives by means of lectures and practical demonstrations to avoid the misuse of explosives, and also to investigate any accidents which might occur.

I have the honour to be,

Sir,

your obedient servant,

A. Desborough, Capt.,

H. M. Inspector of Explosives.

MEMORANDUM.

Magazine Construction Committee.

The Committee should consist of a member of the Mines Department, a representative of the Militia Department, a representative of the Public Works Department, and two members of the explosive trade.

The object of the Committee would be to test different natures of construction by exploding from a half to one ton of explosive inside each building, and noting the distance to which the débris is projected.

The Committee should satisfy themselves that each building is reasonably secure against unlawful entry.

I would suggest that the explosive be invariably stacked at one end of the building, so as to leave as great an air space as possible from the other end. This point is especially important where the construction is of concrete.

The types of construction which might be experimented with are as follows:—

1. Expanded metal and cement plaster.
2. German special re-enforced concrete.
3. Log magazine.
4. Any type which the Committee suggest.

I think the attention of the Committee might be directed to the possibility of the expanded metal being carried above the roof, and also being grounded to form an economical system of protecting from lightning.

Transportation of Liquid Nitro-glycerine by Road.

Mr. Lowry, at the recent conference, raised this point with regard to the use of liquid nitro-glycerine in opening oil wells.

When nitro-glycerine was first used on a commercial scale, it was invariably transported in the liquid state. In consequence of the large number of accidents which occurred, the practice was prohibited in all European countries. Alfred Nobel then absorbed the liquid in an infusorial earth, solely with the view of rendering its transportation reasonably safe, and with the intention of extracting the nitro-glycerine by a process of displacement by water when it had been transported to the place at which it was required to be used. He found, however, that for ordinary blasting purposes it was not necessary to use the nitro-glycerine as a liquid, and he called the plastic explosive dynamite. I have been told that it is essential to use liquid nitro-glycerine in opening oil wells, but I do not know if this practice is universal. If it is absolutely necessary to do so, I think that at any rate the nitro-glycerine should not be transported as a liquid but as dynamite. In Great Britain dynamite No. 1 is defined as a mixture of not more than 75 parts of nitro-glycerine absorbed in kieselgur.

A factory license could then be granted to allow of the nitro-glycerine being displaced in the immediate neighbourhood of where it was intended to be used; the operation to be effected in a definite building and to be under proper control and supervision.

SESSIONAL PAPER No. 26a

Testing Station and Chemical Laboratory.

I attach to this paper a rough specification of the testing gallery which is being erected in England. The sketch drawings mentioned in the specification have been omitted, as there was not time to have copies made before I left England.

The ballistic pendulum is shown in detail on the plan furnished herewith. I may mention that the bob of the pendulum consists of a 13″ mortar, weighing 5 tons.

I have not yet received plans of the gun which it is proposed to use in England.

It will be necessary to erect an observation chamber at least 15 yards from the gallery. The front wall should be substantial, and fitted with narrow horizontal windows, suitably protected against the possible, but very remote, chance of a disruptive explosion in the gas gallery.

It will also be necessary to provide several sheds, or a shed divided into compartments, to be used as a safety lamp room, oil store, coal store, coal dust disintegration. Two small magazines should also be erected for the storage of explosives awaiting test, and for detonators.

Narrow gauge rails will have to be laid for use in connexion with the gas gallery and pendulum. It would be convenient if the rails were so arranged that the guns in use could be shifted from the gallery to the pendulum, or vice versa, as required.

At the station in England it is proposed to install a gallery for testing safety lamps, but the details have not yet been settled. The general idea is that the explosive atmosphere will be prepared in the explosives testing gallery, and that a branch gallery of small sectional area will lead from the big gallery through the lamp testing chamber back of the gallery.

The estimated cost in England of the above is £3,000, but I would suggest that a second gun be obtained (cost about £600). These guns are manufactured in the Royal Arsenal, Woolwich.

As far as the chemical laboratory is concerned, the only special feature to be attended to is the provision of a separate compartment, or a small detached building with a north light, in which stability tests will be carried out. It is essential that the atmosphere in which these tests are carried out should not be contaminated with acid fumes.

A very small detached shed of a few cubic feet capacity should be erected to store samples of explosive submitted for chemical examination. It is not advisable to store these samples in the testing gallery magazine, as they will doubtless often be of low chemical stability.

I attach a rough sketch of the disposition of the new apparatus in England.

(Signed) **A. Desborough,** Capt.

COLLECTION OF DATA ON EXPLOSIVES INDUSTRY, AND REPORTS ON ACCIDENTS IN MINES AND EXPLOSIVES FACTORIES, ETC.

I.

Joseph G. S. Hudson, M.E.

In compliance with instructions, I proceeded to collect and compile data and information necessary for the preparation of a draft Bill, as the basis of legislation for regulating the manufacture, importation, and testing of explosives in Canada.

This work necessitated visiting the principal explosives factories now in operation throughout the several provinces; interviewing the departments of the Provincial mining bureaus; and the explosives, mining, and transportation interests in the Dominion.

On July 22, 1910, Captain A. P. H. Desborough, one of His Majesty's Inspectors of explosives for Great Britain—who, at your request, was loaned by the British Government, to make a report on the explosives industry of Canada—arrived in Ottawa.

After several consultations, as to the general scope of the proposed legislation to regulate the use of explosives in Canada, I received instructions to accompany Captain Desborough on a tour of inspection: to visit the representative explosives factories and principal mining districts; so as to give him an opportunity of personally investigating conditions as they exist in Canada. This inspection was to terminate before the expiration of Captain Desborough's leave of absence, allowing time for a conference to be held in Ottawa, at which the representatives of the explosives and mining interests would have an opportunity of hearing, and discussing the recommendations which he proposed to submit in his official report.

With this object in view, the following explosives factories were visited in the Province of Quebec:—

The high explosives factory at Beloeil, and the black and sporting powder factory at Windsor Mills—both of these plants being operated by the Hamilton Powder Company; the high Explosives and black-powder factory at Isle Perrot, near Vaudreuil—owned by the Standard Explosives Company of Montreal; the dynamite factory at Lavigne—operated by the Northern Explosives Company; the rack-a-rock explosives factory at Sherbrooke; the fulminate of mercury at Capelton; and the Dominion Cartridge Company's factory at Brownsburg; where ammunition cartridges, and electric and explosive detonators are manufactured.

After inspecting the Quebec factories, magazines, and principal coal mining districts of British Columbia, we proceeded direct to Victoria, so that the Honourable, the Minister of Mines—W. Templeman, Esq., M. P.—might have an opportunity of discussing with Captain Desborough, the main features of the proposed Explosives Bill.

Interviews were obtained, while in Victoria, with the Honourable Richard McBride, Premier and Minister of Mines of British Columbia; Mr. Wm. Fleet Robinson, Provincial Mineralogist; and Mr. Francis Shepherd, Chief Inspector of Mines for that Province. At these interviews the proposed Federal legislation to regulate the manufacture, importation, and testing of explosives was discussed, and the co-operation of the Provincial Mining Bureau obtained.

We also inspected the following explosives factories, namely—the Hamilton Powder Company's plant at Northfleet bay, near Nanaimo: where they manufacture high explosives, black-powder, and Monabel powder; the last named explosive is on the "*Permitted List*" of Great Britain. The Hamilton Powder Company are manufacturing Monabel powder, under direct control of the Nobel Explosives Company, Glasgow, Scotland; for use in the gaseous and dusty coal mines of British Columbia.

The Grant Powder Company's factory—situated at Telegraph bay, near Victoria—was visited. This factory does not make any explosives other than dynamite in its several percentages.

The newly established explosives plant of the Western Explosives Company—a branch of the Standard Explosives Company—situated on Boon island, Howe sound, 16 miles from Vancouver, was also visited. At this factory, dynamite and black-powder are manufactured.

Under special instructions from the Honourable the Minister of Mines, representative coal mining districts were to be visited in British Columbia to allow Captain Desborough to have an opportunity of personally discussing the proposed Explosives Bill with the coal operators; particularly the regulations which would be framed, and the tests made, for powders to be placed under the "*Permitted List.*"

Consequently, Bankhead, near Banff, Alta., and Fernie, B. C., were selected for inspection, and the question of "*Permitted Explosives*" was thoroughly discussed with the mine inspectors and officials at these places. The large, distributing explosives magazine of the Hamilton Powder Company, situated at Kootenay lake, near Nelson, British Columbia, was also visited, and the question of distribution, storage, and transportation of explosives from central points was inquired into.

Cobalt was also visited: as being a representative hard rock mining district. While in this district several storage explosives magazines were inspected, and the subjects of storage, transportation, and testing of explosives were discussed with the president of the Timiskaming Mine Managers' Association.

On returning to Ottawa, we proceeded to the Province of Nova Scotia, and visited the coal mines at Glace Bay, Sydney Mines, and Stellarton, and had interviews with the management of the several coal companies, and representatives of the Provincial Workman's Association; who all expressed the opinion that, the proposed Federal legislation regulating the manufacture and importation of explosives was absolutely necessary, and that the establishment of an Explosives Testing Station at Ottawa, under the supervision of the Mines Branch of the Department of Mines, had become necessary, in order to safeguard the men employed in coal and metalliferous mines, and on railways, and other construction works in Canada.

On leaving the coal districts of Pictou and Cape Breton, it was deemed advisable to interview, at Halifax, the Deputy Commissioner of Mines, and Attorney-General of the Province, with regard to the proposed legislation.

The works of the Acadia Powder Company, situated at Waverley, near Halifax, Nova Scotia, were visited. At these works dynamite, black-powder, detonators—both fuse and electrical—are manufactured.

After leaving Halifax, we stopped over on our way back to Ottawa, at Montreal, to interview the heads of the railway departments of the Grand Trunk and Canadian Pacific railways, relative to the transportation of small quantities of explosives on regular trains. This question was taken up in order to safeguard the public; since it is a well-known fact that, in the mining districts where prospecting and assessment work is being performed, quantities of explosives are illegally carried in suit cases and dunnage bags. It is, therefore, proposed that the railway companies shall provide special boxes, of a pattern authorized by the Explosives Division of the Mines Branch, and the Board of Railway Commissioners for Canada: so that small quantities of explosives may be shipped by regular freight trains, and without excessive freight rates; and thus remedy the present dangerous method of carrying explosives clandestinely.

The railway officials acknowledged that this would be a move in the right direction, and promised hearty co-operation with the Explosives Division of the Mines Branch, in carrying this proposed rule into effect, when the Explosives Bill is passed.

Interviews were held at Toronto with the Deputy Minister of Mines for the Province of Ontario, with respect to the application of the proposed Federal legislation; who promised co-operation with the Federal Department of Mines in carrying out the proposed regulations within their jurisdiction.

The fireworks factory at Hamilton was also visited, and many matters discussed with the management relative to the application of the proposed Explosives Act; particularly to the class of fireworks used, and explosives imported, by the railway companies of Canada for *signalling purposes.*

At Kingston, we met by appointment the management of the Ontario Powder Company, and also visited the detonator factory at Arnprior.

Two explosions of explosives—attended with serious loss of life, occurred in close proximity to the city of Ottawa, during the year; and a very disastrous coal mining accident occurred on the 8th of December, 1910, at Bellevue mine, near Frank, in the Province of Alberta, which resulted in 31 men losing their lives. Pursuant to instructions, I attended the inquests in connexion with each of these disasters, and have made detailed reports thereon. (See pages 137, 140, and 144 respectively.)

"Virite" Explosion at Hull, Que.—View showing evidence of the force of the blast caused by explosion.

View showing disruptive force due to concussion.

Remains of magazine after explosion.

View showing direction of projected stone through house.

View showing direction of projected stone through house: which killed two persons sitting on door step.

View showing path of stone into slanting roof and out through gable end.

View showing where stone struck house and rebounded: killing one person and injuring another.

House 1,500 feet from magazine: where two girls were killed.

Rear of house: showing stones which killed the two girls.

DEPARTMENT OF MINES

MINES BRANCH

[illegible] Flow LL.D. Deputy Minister

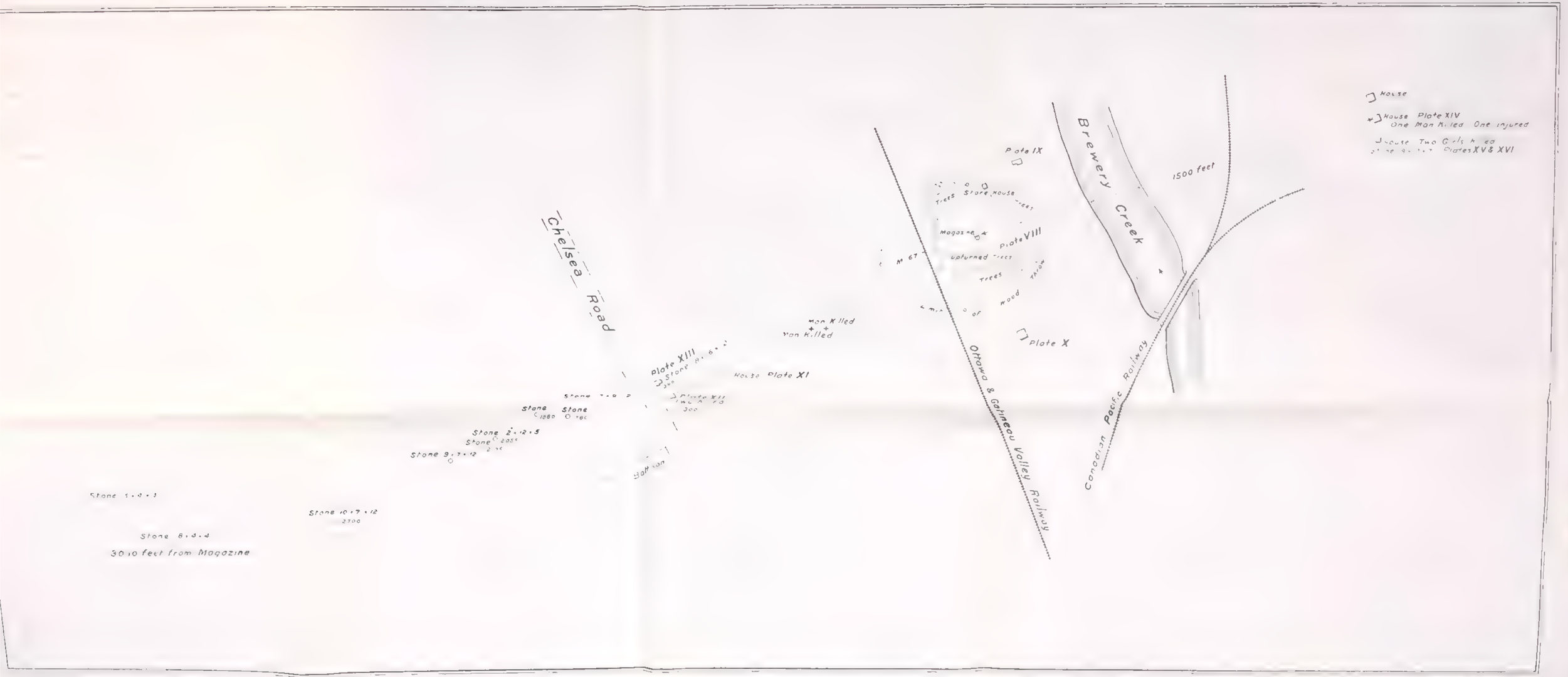

Fig. 1

Plan showing distance to which stones were hurled by the Explosion of a [illegible] Magazine on the Gatineau Power Co's Property in the Province of Quebec on Sunday May 8 1910

II.

REPORT ON EXPLOSION OF "VIRITE" AT THE WORKS OF THE GENERAL EXPLOSIVES COMPANY, LIMITED, HULL, QUEBEC, MAY 8, 1910.

The General Explosives Company, Limited, was incorporated as a company in the Department of the Secretary of State for Canada, on the 4th day of July, 1905.

As stated in the letters of incorporation, the object of the Company is: "To carry on the business of manufacturing explosives of every description: gunpowder, nitro-glycerine, dynamite, gun-cotton, blasting-powder, or other like substances or things, and of purchasing, selling, and generally dealing in explosives and all materials, substances, and things, required for or incidental to, the manufacture, preparation, adoption, use, or making of explosives, or the packing, storing, firing, or disposition thereof."

On the 11th day of November, 1908, the following trade mark was registered in the Department of Agriculture, Ottawa:—

"I, Ernest Arthur LeSueur, a citizen of the Dominion of Canada, and resident of Ottawa in the county of Carleton and Province of Ontario, do hereby request you to register in the name of myself a specific trade mark to be used in connexion with the sale of explosives, which I verily believe is mine on account of having been the first to make use of the same.

"I hereby declare that the said specific trade mark was not in use to my knowledge by any other person than myself at the time of my adoption thereof. The said specific trade mark consists of the word 'VIRITE.' Trade mark No. 13203."

The plant of the General Explosives Company, Limited, was situated within the corporated limits of the city of Hull, in the Province of Quebec; being located on a strip of land 500 to 600 feet in width, lying between the main line of the Canadian Pacific railway, and the line of the Ottawa and Gatineau Valley railway (the magazine which exploded being within 250 feet of the last-named railway) on a bank over of the Ottawa river known as Brewery creek, about one-half mile north of the Hull railway station.

The plant consisted of a watchman's shack, mixing and packing-house, office building (which was also used for storage purposes), soda dry house, chlorate of potash storehouse, and stone masonry magazine.

About 5 p.m. on Sunday, May 8, 1910, the shack occupied by the watchman (who was at the time absent) was observed to be on fire, and in a very short time the fire was communicated to other buildings.

About forty minutes after the first indications of fire were observed, a slight explosion occurred. As to the precise quantity of explosives exploded at this time it is uncertain, as no definite record could be obtained; but it was ascertained that a large quantity of detonators were stored within a few feet of the main magazine. A very short time after the first explosion was heard, a second explosion occurred, accompanied by great violence, and disruptive force: the stones from the magazine being propelled for a distance of 3,050 feet in one direction and over 1,500 feet in the opposite direction: killing ten persons, injuring twenty, and destroying valuable property.

It is stated that, at the time of the explosion, the magazine contained 9,500 pounds of manufactured "virite," packed in 50 pound boxes.

Late on the previous Friday, 20,000 pounds of this same explosive had been shipped, which was fortunate, for if this total quantity had exploded, the loss of life and damage to property would in all probability have been enormous.

The explosive named "virite," as manufactured by the General Explosives Company, Limited, is a chlorate of potash compound.

The magazine in which the explosion took place was of stone construction, the walls being nearly 2 feet in thickness.

The magazine was licensed by the Provincial Government of Quebec, and had been subject to inspection by Mr. Louis Guion, Chief Inspector of Industrial Establishments and Public Buildings, to the city of Montreal, who verified the fact in his evidence before the Coroner at the inquest held on the bodies of the people killed by the explosion:—

"The magazine undoubtedly was built according to regulations under the statutes, there is no doubt about that. It has been described, and there was nothing wrong about the magazine under the existing statutes; but the storing of these detonators, in my estimation, near the powder magazine, readily opens a theory as to what caused the explosion in the magazine."

That the great loss of life was due to the magazine being of stone construction is, without doubt, absolutely true, as the stones used in its construction were hurled as though they were projectiles.

No written description can represent the force with which they were propelled as can the accompaning illustrative Plates I to IX—showing the destruction to the contingent buildings; and the diagram, page 136, which shows the distances to which they were hurled.

The plant where the explosive "virite" was manufactured was surrounded by a growth of cedar scrub trees and underbrush; the surface formation having little or no soil. The magazine was built on practically solid bed-rock.

The ground was comparatively level and about the same elevation as the surrounding country; except towards the west, in which direction the surface rises gradually up to, and over the Chelsea road, having a possible elevation of 75 to 100 feet in a distance of 1,000 feet.

The disruptive force, and the projectiles from the explosion, did a large amount of damage to outside property. One noticeable feature (see diagram) was the short distances any wood used in the construction of the buildings was thrown; in comparison to the greater distances to which stones used in the construction of the magazine were propelled: indicating the necessity of having well defined rules and regulations laid down, governing all explosive magazines built in the future.

DAMAGE TO OUTSIDE PROPERTY.

The nearest tenement to the seat of the explosion was a frame building, very fortunately unoccupied at the time (see Plate IX). As indicated by the illustration, it was completely wrecked. Seventy-five feet in a northerly direction was a frame stable, the sides and roof of which were badly damaged. A distance of 400

feet from the seat of the explosion, and located on the edge of the creek, but partly protected by a bank about 18 feet high, was a frame building 50 × 60 feet, occupied by the Hull Fertilizer Company. The end of this building facing the direction of the explosion had part of the roof damaged, the sides torn off, and rafters and beams broken.

Directly south of the plant was a frame structure, with brick smoke stack, and containing machinery: located about 400 feet from the "virite" magazine. This building was badly shattered, and two small adjoining sheds built of wood were wrecked. Between a distance of 400 and 900 feet from the magazine there were no buildings; but, at a distance of from 1,000 to 2,000 feet there were quite a number of buildings which had extended from the main part of Hull towards the plant of the General Explosives Company. Damage to these buildings was altogether due to the stones—with which the magazine walls had been constructed —being hurled with terrific force. Stones weighing 30, 40, and even up to 100 pounds in weight, smashed like cannon balls through the frame houses. In many instances, portions of fields were ploughed up, and the stones completely buried by the force with which they had been propelled.

The ten fatalities were due to stones, which were blown from the magazine, and were found about the following distances from the base of the explosion:—

Boy in field to west of the magazine.....	650 feet.
Man on the railway track.....	1,000 "
Three men near railway bridge on creek.....	1,050 "
Man at corner Eugene street, Chelsea road.....	1,500 "
Two girls in house, Chaudière street, Hull.....	1,500 "
Man on the street.....	1,500 "
Small boy in field east of the plant.....	1,600 "

PEOPLE INJURED.

It was ascertained that 20 people were injured, many very seriously; and the effects of shock were felt by a great number. It was marvellous that so many escaped; for when the alarm was given that the factory was on fire, a large crowd of people from a nearby baseball game gathered about the factory. Apparently, when the explosion took place, the heavy stones and timbers were hurled right over the heads of the crowd, without injury; while the people killed were at greater distances away, and not in the immediate vicinity of the magazine.

In conclusion, I may say that, it is a difficult matter to advance any positive theory as to the direct cause of the explosion, since not a vestige of the plant remained: (see Plate X). What is known with certainty is, that a fire started, and was transmitted from one building to another, until the explosion occurred. The jury empanelled by the Coroner to inquire into the cause of death resulting from this explosion, rendered the following verdict:—

"That the deceased, Antoine Servant, came to his death on the 8th day of May, 1910, at 5.45 p.m., as a result of being struck by a stone hurled against him by the explosion of 'Virite' at the magazine of the General Explosives Company, of Montreal, Limited, at Hull, and without holding said Company criminally responsible, we consider it guilty of certain imprudence in storing a quantity of

detonators in close proximity to their magazine, and also in not keeping a regular watchman constantly upon the premises; and we recommend to the Government of this Province such amendments to the laws and regulations concerning the manufacture and storing of explosives as will secure the greatest safety to the public, and that in no case shall factories or store houses be allowed in the limits of cities, towns, or villages, and that this verdict applies to Ferdinand Lauren, Theodore Gagne, William Sabourin, Louis McCann, Donat Fabin, Rosalie Carriere and Emelia Carriere."

It may be stated that the directors of the General Explosives Company, Limited, paid, voluntarily, all damages to buildings and property caused by the explosion; and, moreover, fully compensated, by money, the people who were dependent upon those who were killed, also provided for those who were seriously injured, without a single action-at-law, for damages, being taken against the Company.

On the extent of the disaster becoming known, the Mayor of the city of Hull started a fund for the relief of the sufferers, which was liberally subscribed to by the general public; but on the settlement of the claims, the directors of the Company returned to the subscribers the amounts of their subscription.

III.

REPORT ON EXPLOSION OF "BLASTERS' FRIEND" AT THE WORKS OF THE DOMINION EXPLOSIVES COMPANY, LIMITED, SAND POINT, NEAR ARNPRIOR, RENFREW COUNTY, ONTARIO, JULY 11, 1910.

Investigation of the disaster attending the explosion which occurred in an explosives factory operated by the Dominion Explosives Company, Limited, at Sand Point, a small village on the Ottawa river, 6 miles above Arnprior, in the county of Renfrew, Province of Ontario, on July 11, 1910; whereby, three men were killed on the spot, namely: Frank Pittner, John Hewart, Earl Murphy; one seriously injured: Edward Lynn; and seven slightly hurt: Charles Thomas, Thomas Mullet, John Chalterton, W. Bradley, Supt. Matchette, David Lynn, Donald McLean; all as a result of the explosion.

The Dominion Explosives Company, Limited, was incorporated under the Dominion Government, and received a charter from the Department of the Secretary of State, on the 3rd day of March, 1910. A patent, No. 116625, was granted to Henry G. Nicoll, by the Department of Agriculture on the 9th day of February, 1909, for an explosive compound, and process of making the same: also patent No. 125632, on the 10th day of May, 1910, granted to Henry Garwin Nicoll, for a mixer for a process of part of the manufacture of explosives. These patents were transferred to the Dominion Explosives Company, who own and operate the factory at Sand Point. The explosive is manufactured and supplied to the trade under the name of "Blasters' Friend;" and is described, as "an improvement in explosives compounds." The object of the invention is, to produce

a non-freezing powder, which may be used as a substitute for any nitro-glycerine dynamite; having equal disruptive power with the same, and greater stability for the same grade, weight, and bulk.

The base of the explosive is the product known as Cassava flour; it being claimed by the patentee that, better results and more efficient nitration are secured by the use of Cassava flour in comparison with other forms of nitrated starch.

(This Cassava flour is really the by-product of the tapioca factory, as from Cassava the tapioca of commerce is obtained.)

The manufacture of the explosive known as the "Blasters' Friend," may be briefly described as follows:—

The Cassava flour as it is received at the works is in a dry form, but, if it has absorbed any moisture, it is dried by being heated with hot air at a temperature of nearly 260° F. After drying, the Cassava flour is allowed to cool to a temperature of 60° F., before being subjected to the process of nitration.

The nitration of the Cassava flour is effected by gradually sifting the flour into a mixture of nitric and sulphuric acids, prepared ready for use in accordance with the following formulæ:—

	Per cent.
H_2SO_4	63·30
HNO_3	34·50
H_2O	2·20
	100·00

It is claimed by the officials of the Company that the best nitration is obtained by using four parts by weight of the mixed acids to one part of the Cassava flour.

The Cassava flour is introduced into the mixed acids by sifting the flour into the surface of the acid, and by mechanical agitators, giving a thorough precipitation, the temperature being maintained between 60° and 70° F., and not allowed to approach 90° F.; the cooling process being facilitated by water circulating around the tank, in which the nitration is being carried on.

The usual time required for the process of nitration is 55 to 60 minutes, to as long as 1½ hours; the determination of the proper degree of nitration being regulated by the condition and appearance of the mixed nitrated liquid and Cassava pulp.

When the process of nitration has been satisfactorily performed, the mixture is withdrawn from the nitrator, and is allowed to run down by gravity, and shovelling through a flow of water, by three separate oval bottomed shaped tanks, each tank being 12 feet in length and having a drop of about 20″ from one tank to another. During this process, the acids in the nitrated Cassava flour are washed out, but in the event of any portion of the mixed acid remaining, a tank similar in construction and design to those above mentioned is placed at right angles to the three down flow tanks, in which is held an ammonia solution of about 26 per cent, the object of which is to neutralize any acids left in the Cassava flour.

The next operation is to lift the nitrated Cassava flour sludge, and put it into a centrifugal spinner, to drive off as much water as possible, and to recover the spent acids. The nitrated flour is then conveyed to the drying house, which is fitted up with drying closets, where the nitrated sludge is placed in nine pound lots, on wood frames, and covered with fine canvas or cloth. Into these drying closets a forced draft of hot air at a temperature of from 90° to 100° F., is circulated.

When the nitrated Cassava flour is dried, it is in the form of a very fine powder, varying in colour from a light to a dark yellow, forming the base of the non-freezing powder, and is in a condition for its final mixing.

An analysis of this powder, at the stage just described, gives from 13 to 14 per cent of nitrogen.

The dried nitrated Cassava flour is now mixed with a fixed percentage of sodium bicarbonate, which is claimed by the officials of the Company to give an extremely stable explosive, non-freezing, and readily detonated by a standard fulminate cap.

To give this powder body for saleable and resultant purposes, a small percentage of powdered charcoal, mineral and vegetable oils is introduced.

When the above-mentioned compound is thoroughly mixed, it has the consistency of a dry, but plastic, finely divided, slate-coloured powder, which readily adapts itself to packing in the ordinary explosive waterproof paper cartoons; graduated in diameter to meet the requirements of the trade.

So far as I am aware, the manufactured explosive known as "The Blasters' Friend" has not been "tested," except in the chemical laboratory of the Bureau of Safe Transportation of Explosives, New York; for transportation over the railway lines of the companies subscribing to this bureau.

The chemist of this bureau gives the following information:—

> "Temperature of ignition, 155° C.
> Impact test 8 pounds weight, fall 5 inches.
> Friction test 8 pounds weight, 6 inches.
> Powder did not ignite nor explode when shot into with a 30 calibre military rifle bullet. It is detonated with a single strength cap.
> When unconfined, it is readily ignited by a spark or flame, and burns rapidly, but quietly. It is classed as a high explosive, and is considered sufficiently safe for transportation. The probable efficiency of this explosive is not considered in this report."

The disaster under investigation occurred in the drying house of the plant, and such was the force of the explosion that not a building remained standing: being destroyed either by the disruptive force of the explosion, or by fire.

This was in some measure due to the fact that many of the buildings had originally been erected for purposes other than for an explosives factory and were closely grouped together, and inasmuch as we have not, at the present time, an Explosives Act in force in Canada—whereby specific distances are maintained between danger buildings—the whole plant was annihilated; the wood used in the construction of the buildings being torn and splintered into very minute fragments.

The inquest on the bodies of the men killed was held at Sand Point on the 18th of July, 1911, and in compliance with your instructions, I was in attendance. Dr. Armstrong, of Arnprior, was coroner, and Mr. Metcalf—the Crown Attorney for the county of Renfrew—conducted the inquiry.

The principal witness was Mr. I. D. Matchette, superintendent of the Explosives works, who in his evidence stated that he had had two years' experience in the manufacture of an explosive similar in composition to that known as the "Blasters' Friend," and that he had been employed nearly all his life in powder factories. He stated that the Dominion Explosives Company had been making the explosive known as the "Blasters' Friend," for a period of six weeks.

Frank Pittner and John Hewart—two of the men killed—had been brought as specialists to the works of this Company at Sand Point on account of their experience in the United States in the manufacture of the class of explosives such as was being made at the plant of the Dominion Explosives Company.

He (the superintendent) knew of his own personal knowledge that they were capable, careful men; one being employed at the nitrator, and the other in the drying room.

Superintendent Matchette stated in his evidence that he was in the drying-room two minutes before the explosion occurred, and to the best of his knowledge, conditions were as usual, the thermometer indicating the heat was normal.

The workmen who were employed in the drying-room and other danger buildings were provided by the Company with special clothes: such clothes as are usually worn in explosives factories, without metallic buttons, or pockets; felt and rubber soled boots being provided; and the men are periodically subjected to a search to prevent matches or other dangerous articles from being taken into the works. In the construction of the drying-house and other danger buildings, the nails in the boards were counter sunk and putty inserted over the heads; copper nails being used where any exposure was unavoidable.

The superintendent stated that he had no idea how or in what manner the fire originated, or how the explosion occurred, every precaution within his knowledge having been used. The employes were personally warned, also by means of printed notices, to be careful; and that disregard of instructions meant injury to themselves and to their fellow workmen.

There were about 100 cases stored—each case containing 50 pounds of explosive—in the packing house, which was about 150 feet distant from the drying-house. It is claimed that this explosive did not explode, but was burnt.

After an exhaustive examination of all available witnesses, the jury retired to consider their verdict which was rendered as follows:—

> "We the jury empanelled to investigate the cause of the death of the late Frank Pittner, killed in the Dominion Explosives Limited factory, near Sand Point, on July 11, 1910, find:" "That his death was caused by an explosion, originating in the drying-room from causes which we are unable to determine, and after full and exhaustive examination find that no blame can be attached to any of the officials or managers of the Company, who in our judgment used all due precautions in the erection of their buildings and manufacture of their product."

IV.

INVESTIGATION OF THE COAL MINE DISASTER AT BELLEVUE MINE, NEAR FRANK, ALBERTA.

Joseph G. S. Hudson.

Letter of Instruction.

OTTAWA, December 12, 1910.

DEAR SIR:—

You are instructed to proceed at once to Bellevue, near Frank, Alberta, for the purpose of investigating the recent accident from an explosion, which occurred at the coal mine at that place.

1. It will be your duty to obtain a full description of the disaster.

2. You will endeavour to ascertain, if possible, the cause of the disaster.

3. And ascertain whether the method of mining is defective, in that it prevented the escape of the miners after the explosion.

4. To make such suggestions as will in future avoid at that mine or mines with similar lay-out loss of life from the probable cause mentioned under No. 3.

You are to be present at the inquest and take notes of all that is said in evidence.

To report on any other essentials which may be necessary for a comprehension of the causes of the disaster, and its possible prevention in future from similar causes.

Yours truly,

(Signed) **Eugene Haanel,**
Director of Mines.

JOSEPH G. S. HUDSON, Esq.,
Mines Branch,
Department of Mines.

REPORT ON BELLEVUE MINE DISASTER.

DESCRIPTION OF MINE.

The Bellevue mine is one of three mines operated by the West Canadian Collieries Company, Limited, and is situated near Hillcrest station, Alberta, on the main line of the Crows Nest Pass division of the Canadian Pacific railway, and is in close proximity to the divisional line between the Provinces of Alberta and British Columbia.

No. 1 Mine: The underground Working in Which the Disaster Occurred.

This mine is opened from the surface by a stone drift until it reaches the coal, when a gangway and counter gangway are driven on a course having sufficient angle of inclination to allow water to flow from inby to the mine entrance.

From the main gangway chutes are driven on the full pitch of the seam, the chutes having 50 ft. centres. From the chutes, rooms are driven from one gangway to another, and the coal is run down the chutes, where it is loaded into mine cars on the main gangway, and hauled out to the surface by means of compressed air locomotives.

The main gangway has been driven in, a distance of 8,200 feet from the slope opening.

There are two openings designated on the plan as No. 1 and No. 2 mine.

From No. 1 mine, gangway 129, chutes have been driven north, and 35 south the south gangway is not now in use; while from No. 2 mine 24 chutes have been driven.

The geological features are peculiar, in that what may appear as two seams, probably may be proven to be but one, as an anticlinal has been discovered in the workings, which shows a complete fold over in the coal seam.

Between chutes 61 and 62 in No. 1 mine, a rock tunnel is being driven through the intervening strata, to connect the underground workings of both seams.

For the purpose of ventilation and exit from the underground workings of No. 1 mine, the following chutes have been driven to the surface:—

No. 26 chute, not now used,

No. 45 chute (first chute to surface),

No. 81 chute on this chute is the return airway from the mine workings of No. 1 seam.

No. 110 chute is being driven to the surface, the work has just been started, and it has to be driven 180 feet through very hard rock to the surface to complete the exit.

The ventilation fan is of the Sorocco type and is placed 400 feet from the mine entrance on the Main Rock tunnel, and forces the air along No. 2 seam main level to 53 chute, where a rock tunnel connects with No. 1 seam, at No. 1 chute north, and is carried along the main gangway to the working faces.

The official record as to the total quantity of air circulating in the mine on November 30, 1910, is as follows:—

No. 1 rock tunnel	62,720	cubic feet per minute.
Inside of 46 chute	25,900	∫ included in
Inside of 82 chute	20,160	⎩ total quantity.

The seam of coal worked varies from 11 feet to 12 feet in height, having a hard rock roof, and lies at an angle of inclination varying from 45 to 80 degrees.

HISTORY OF ACCIDENT.

On October 31, 1910, the Bellevue mine was idle on account of a general holiday, "Thanksgiving Day," and in consequence there were not any men working in the mine underground.

While some men were engaged in erecting a power transmission line over the surface of the ground, under which were situated the underground workings, they were much surprised to see a cloud of dust and debris issuing with considerable force from the mouth of the chutes into the open air.

On an investigation being made by the mine officials it was found that the escapement doors of the ventilating fan had been blown open, and at the surface openings debris was strewn all around.

Knowing that no men or lights (even safety lamps) were at the time in the mine, it seemed an unusual occurrence that a mine explosion had taken place, and considerable anxiety was felt as to the probabilities of a second explosion following the first.

After a consultation held between the mine officials and Mr. James Ashworth, the General Manager of the Crowsnest Pass Coal Co., and Mr. Heathcote, the District Inspector of Mines, it was decided to test the air from the mine at the bottom of the fan and other openings, and if the return air from the mine did not show a large amount of CO, CO_2; or CH_4 gas, or that it did not show a temperature above normal, that an exploration party should enter and examine the mine to ascertain to what extent the explosion had wrecked the underground workings, or if any fire remained in the mine unextinguished after the explosion, and if possible, to arrive at some conclusion as to what had caused the explosion.

Mr. James Ashworth, in his evidence at the coroner's inquest, connected the explosion on "Thanksgiving Day" with the disaster which occurred on the 9th of December. He was asked by the General Manager of the West Canadian Collieries Company to come to Bellevue for consultation as to whether a fire existed in the mine or not: due to the explosion on "Thanksgiving Day."

After making several tests on the surface it was decided that no fire did exist in the mine, and that an exploration party would go into the mine and make an examination of the underground workings.

On entering the mine, it was clearly demonstrated that an explosion of considerable force had occurred, from 75 chute inwards: the effects of force being clearly indicated by the way the air stoppings were blown out; and along the gangway, mine cars, etc., were covered with mud showing the evidence of considerable force. On going up No. 81 chute, coal was found perceptibly warm. On the way back they went up No. 71 chute, and perceived that a large section of the roof of the mine had caved in. On the previous Friday a miss-shot had been left in the coal, and not fired in the section where the cave-in had occurred. No decision was arrived at as to whether this shot had exploded or not; but it was thought that the percussion from the caving in of the roof of the mine was sufficient to cause the damage which was in evidence in the mine, hence it was concluded that no fire existed in the underground workings of the mine.

One of the fire bosses who accompanied this party has given me the following account of his own observations which he had carefully written down on his inspection, and which I think is important:—

"On the counter (gangway) at 99 chute, the force left 3 distinct trails:

1. Inby to No. 105 chute;
2. Outby towards No. 82 chute;
3. Down the chute to the gangway.

"At this point, a trip of mine cars was standing on the parting.

"The first was an empty car, with a defective door, which was being sent out for repairs. The second car was filled with rock, as also was the third car. The force of the explosion struck the trip, (connected series of cars), and separated the first two cars from the rest of the trip, and carried them forward for about 12 feet and over on to the empty track, reversing their position; the empty car now being inby (the car of rock would weigh approximately 6 tons) the third car was thrown off the track and towards the other cars. The coupling which connected the second and third car remained on the front end of the third car and the clevis and pin which had connected them to the third car was drawn out nearly straight. The force of the explosion went inby on the main gangway as far as 118 chute when it became expended, as evidenced by the mud on the outby side of the chutes, props, etc., and by the fact of the props inclining inby in the tops. Most of the chutes were damaged in to No. 106. Past that point none were damaged. On the counter gangway all the air stoppings were blown out as far as 106 chute, the wheel valve of No. 104 chute charging station (where the compressed air locomotives receive their pressure of air) was carried inby for about 18 feet, and the charging station itself, weighing about 80 pounds, was blown inby for a distance of 50 feet.

"No. 99 chute shows evidence of the force having come down there from the counter gangway. This seems to have been the main trail of that branch of the force although 98, 97, 96, and 95 chutes show evidence of the force having also gone down from the counter to the main gangway.

"From 109 to 94 chutes, the inby sides of the posts show evidence of a slight recoil, and from 94 chute outby the recoil has been much stronger.

"The boards and canvas opposite the 6th X cut 98 room were burned, and traces of coking were observed between 98 and 81 chutes. Gas (CH_4) was in 98 and 96 (40 feet), the dust (coal) was very thick in 82, 83, 84 chutes. Heathcote (District Inspector of Mines), Emmerson (Mine Manager), Green (Superintendent of Mines), Hallworth (fire boss), and myself (Brownrigg) went along counter gangway from 52 chute to 106 chute and found all stoppings blown out. We went up 75 chute to 4th X pitch and crossed to 70 chute (roof), still weighting, seemed about 10 feet of rock caved. No gas at this point, but very dusty. Force seems to have come down chutes 70 and 75 and spread north and south along both counter and main gangway. Coal coked on ribs and props."

Note.—Brownrigg informs me that where a piece of the roof falls on the wrought iron sheets in the chutes, a continuous streak of vivid sparks can be seen, and also that when a chute is abandoned, the sheet iron is left in the chutes.

Elijah Heathcote, District Inspector of Mines, McLeod, Alberta, in whose district the Bellevue mine is located, gave evidence in substance as follows:—

On November 2—two days after the explosion—he inspected the underground workings of the Bellevue mine. Travelled right up to the face of the mine gangway: found a thick coating of coal dust on the electric light globes at No. 27 chute (light wires stop here), and mud on mine cars from No. 27 chute: props blown down, coal and debris being strewn along the track outward at 58 chute.

Going up 65 chute and along the counter gangway to 67 chute, we found coking on the inside of the props, showing that the flame travelled outwards against

the air current. From 67 to 71 chutes, the coking was on the outward side of the props, while dust and a trace of coke were on the inside, showing that from 67 to 71 chutes the flame must have kicked back, proceeding up 71 chute to a big cave-in of rock—the rocks being of immense size. Although the pillars from chutes 61 to 70 had been extracted, the pit records show that up to October 29, no cave-in had taken place. It was evident, therefore, that the cave-in which he now saw occurred since the date mentioned. On the outside of the cave-in rooms 52 and 57 and pillars 59 and 60 are in working, getting round the cave at 75 chute to the face of the pillar 250 feet up the gangway.

From 71 to 75 chutes the stoppings in the counter gangway are blown inwards towards the face of the main entry, and from 75 to 85 the stoppings are blown outwards towards the mouth of the mine, showing that the blast must have split at 81 chute: one portion travelling up 31 chute manway to the surface, blowing out the dust; while another portion must have travelled through the cross-cuts off 81 chute, returning down 85 chute, and blowing the stoppings outwards. At 85 chute, the stopping in the counter gangway has a large hole in the middle, but remains intact; while from 99 to 103 chutes the stoppings are blown inwards; the sheet iron in the rooms are twisted and bent inwards from the counter gangway. At 103 chute, the stoppings are intact, but at 110 chute the force of the explosion was manifestly spent, owing to the damp and wet state of the mine. From 96 to 104, in the main gangway, is a large parting, and empty cars standing. The first two empty cars were blown from the empty track to the full track, and mud was on the corners of the inward and outward ends of the cars, showing that two forces of the blast must have met at this point.

The witness also stated that he had had a conversation with Mr. Couthard, General Manager of the West Canadian Collieries, as to the cause of the explosion, and what remedies should be taken to put the mine into better condition. After the explosion of October 31, the mine was put into condition by restoring the ventilation and cleaning the main gangway from broken timbers, etc.

The next stage to be noted is that the Secretary of the United Mine Workers of America, Bellevue division of No. 18 district, telegraphed to Mr. John T. Sterling, Provincial Inspector, at Edmonton, that the men working in the Bellevue mine desired an inspection of the mine. Mr. Sterling wired back asking for a reason why the mine should be inspected outside of the regular visit of district inspector; the Secretary of the Union replied that large quantities of gas were reported in the Bellevue mine. Mr. Sterling then wired to Mr. Heathcote, District Inspector at McLeod, to proceed to Bellevue mine and make inspection, who received this telegram on December 4, late on Sunday night. He stated that on Monday, December 5, he had too much work in his office to go to Bellevue mine. (This is an unfortunate state of things. Inspectors should have ample office and clerical help, so that they can leave immediately for urgent inspection duties; for the inspection of underground workings is of greater importance than attention to mere office routine).

On Tuesday, December 6, Mr. Heathcote arrived at Bellevue at 11 a.m. He went to the mines office at 2 p.m. and saw Mr. Powell the manager (who had only taken over the supervision of the mine on December 1; Mr. Emmerson the manager of the mine when the explosion occurred on October 31 having resigned to accept

a more important position in South America, hence was not available for any information as to the cause of the first accident). He told the mine manager that it was asserted that a considerable quantity of gas was reported to be in the mine, and said that he would make an inspection of the mine on the following morning. Accordingly, on December 7, he went into the mine at 8.30 a.m. with John Anderson the pit boss, and proceeded up to the face of the main gangway at 129 chute, travelled back to 123 room, asking men if they had seen any gas, and also testing the working places for gas, but did not find any. The miner working in 123 room said that he had seen gas about 3 feet back from the face, but brattice was 12 feet back. This room was stopped working until the gas was cleared out. In 121 and 120 chutes, at the faces, gas had been seen. Travelled from 129 to 119 chutes, the places where gas most likely would be found, it being the farthest place from the entrance to the mine and in the higher workings.

In this inspection, he was accompanied by John Anderson, the pit-boss, and on arriving at 27 chute asked Anderson if he knew where there was any gas in the mine; he said no.

On arriving at surface he posted notice according to Mines Regulation Act, Chap. 25, section 46, subsection 3, (1906, C. 25, 546; 1908 C. 20, S. 16.)

It is here necessary to note the conduct of Anderson, the pit-boss, who accompanied the District Inspector in his rounds through a section of the underground workings.

Although at the time they (the District Inspector of Mines and pit-boss) were going around the working faces, he (Anderson) had sent two men to make a special inspection and examination of the section of the mine where the big cave-in from the roof eventually occurred, he did not inform the Inspector of what he was doing. He (Anderson) was told by one of the fire-bosses, that the two men above mentioned had reported having found gas, yet he (Anderson) did not place himself in a position to verify the report of Crandel and Boveio until the following morning, when they reported directly to Anderson that they had found gas. In the face of all this, he actually allowed Heathcote, the District Inspector, to post a notice at the entrance of the mine, that there was no gas in the mine. He knew where the Inspector was staying, and could easily have informed him—even on the following morning—that the men whom he (Anderson) had sent to inspect the section of the mine where pillars had been extracted, reported having found gas in considerable quantities, nor did he report to the Inspector that he had put in a new regulator, on the top room between 79 and 80 chute, which would have a very material effect on the whole volume of the air circulating in the mine.

After the effects of the first explosion had been remedied, as far as repairing the damage done in the underground workings of the mine was concerned, and restoring the ventilation of the mine by renewing the air stoppings, etc., the mine resumed work, and apparently on the part of the management work went on as under normal conditions, although the workmen were evidently not satisfied, as shown by their action in asking the Provincial Inspector for a further examination; and also asking that the Pit Committee of the Bellevue Local Lodge of the United Mine Workers of America make an inspection of the underground workings (this latter inspection did not take place), though Rule 32, Chap. 25, 1906, Coal Mines Act of the Statutes of Alberta, states: —

"The persons employed in a mine may from time to time appoint two of their number to inspect the mine at their own cost and the persons so appointed shall be allowed once at least in every month, accompanied, if the owner, agent or manager of the mine thinks fit, by himself or one or more of the officers of the mine, to go to every part of the mine and to inspect the shafts, levels, planes, working places, return airways, ventilating apparatus, old workings and machinery, and shall be afforded by the owner, agent, or manager and all persons in the mine every facility for the purpose of such an inspection and shall make a true report of the result of such inspection, and such report shall be recorded in a book, to be kept at the mine for the purpose, and shall be signed by the persons making the same, and if the report states the existence or apprehends the existence of any danger, the owner, agent, or manager shall forthwith cause a true copy of the report to be sent to the inspector of the district."

What really happened on the night of the explosion may be taken from the evidence of Mr. John Powell, the manager of the mine:—

Mr. Powell's Evidence.

The manager assumed charge of the Bellevue mine on the 1st of December, 1910 (after the date of the first explosion). On Friday evening, December 9, 1910, at about 7.30 p. m., a man came to his residence, and said that there was something wrong at the mine; he asked him of what nature, and he said he thought an explosion. He went immediately for Frank Lewis, the driver boss, and John Anderson, the pit-boss, and with these men, procured safety lamps at the lamp house, and with other men entered the mine. They went in as far as 43 chute on the main gangway, up to which point no indications were observed as to damage to any extent in the underground workings of the mine. At that point, however, a large cave-in of rock from the roof was encountered. At 45 chute 3 men were found, suffering from the effects of after-damp. These men were gotten out, and sent to the surface. They next proceeded along the main gangway to 61 chute, where a large volume of after-damp was found. At 76 or 78 chute, they found 3 men, who were pulled out; one dead, one breathing, and one badly overcome with gas. He gave orders to close 45 air chute, and to get brattice and repair stoppings to force the ventilation into the inside workings and along the main gangway; after this was done, he got as far as No. 80 chute, where he saw lights (safety lamps) and could hear air blowing off. (This point is a re-charging station for the haulage motor.) At 84 chute there were 21 men found dead, all clustered around the compressed air pipe line. (Note the fact that, safety-lamps were burning, although men were dead). The men kept on working at stoppings, until he reached 86 chute; when Stratton came to this point with the Drager oxygen breathing apparatus. Anderson the fire-boss from Hosmer was with him. (This man in trying to save another afterwards lost his life).

Witness explained the circumstances of getting out the bodies of all the men killed in the main gangway, together with the 16 men who were in the mine at the time of the explosion but who were rescued and brought out alive; only four men were unaccounted for, and these were eventually found between 53 and 54 chutes. They were employed as timber packers, and were brought out of the mine on

Sunday. The finding of these bodies was important since they showed distinct evidence of having been burned. The evidence of George O'Brien, fire boss, from Coleman, who came with the rescue party and assisted at the washing of the bodies, says: that of three bodies, one was burned on the right side of his face; one burnt on both sides, and one had his hands badly burnt (from the clothes of this man whose hands were burnt, a dozen or twenty matches were taken). This witness was asked the direct question. (Q.) What were the burns like? (A.) Fire burns. (Q.) This on your oath? (A.) Yes, I picked the flesh off the bones, flesh looked cooked. This witness was corroborated by several other witnesses as to the burns on the men found at the top of 53 and 54 chutes.

After all the bodies of the men killed had been removed the underground workings were inspected by the Provincial and District Inspectors of Mines, also by the collieries officials; information was gathered and noted, and the same was used at the Coroner's inquest.

It is proposed by the officials of the Company that another airway should be driven to the surface, and the ventilating fan moved to a point near the working faces. After consultation the Provincial Inspector of Mines—Mr. Sterling—decided that the mine be closed, and no one allowed to enter it until after the Company had carried out some of the proposed alterations.

The Coroner's jury after viewing the bodies of the men killed adjourned the inquest until the 19th day of December, 1910, at which date the inquest opened at Bellevue, Alberta. After the opening formalities were gone through, Dr. Malcomson, the medical practioner of the district, was called, and explained the cause of death, namely that the men came to their deaths by carbon monoxide gas poisoning. At this point the foreman of the jury announced that he considered the duty of the jurymen at an end, when the cause of death was known; that the jury were not technical experts to find out why or by what means the carbon monoxide gas was produced; and that as far as he was personally concerned the case to go before the jury ended at this point.

Mr. Campbell, who represented the Attorney-General's Department, for the Province of Alberta, endeavoured to instruct the jury as to their duty, but without avail, and the whole matter was laid (by phone) before the Attorney-General at Edmonton, who gave instructions that the first jury were to be discharged, and a new jury to be empanelled for January 3, 1911.

In accordance with this arrangement, the Coroner's inquest was resumed at Bellvene, on January 3, 1911. After a very long and exhaustive examination of witnesses, which continued until 8·30 p.m. on Friday evening January 13, 1911, the inquest was adjourned to enable the jury to consider their verdict. After four hours' deliberation the verdict rendered was as follows:—

"We do, upon our oath, say that 30 men came to their deaths by carbon monoxide poisoning, and one by a combination of carbon monoxide poisoning and fractured skull, the said carbon monoxide and fractured skull being caused by a cave of rock over chutes 76 to 78."

The jury respectfully submit the following riders to their verdict:—

(1) That more mine inspectors be appointed.

(2) That a "Drager" apparatus station be provided in this district.

(3) That telephones be installed under the supervision of the chief inspector of mines, where practicable in the underground workings of coal mines.

(4) That a thorough investigation be made of the means of preventing loss of life by caves-in in coal mines.

(5) "We consider that negligence is in evidence on the part of both operators and miners on the carrying out of the provisions of the Coal Mines Act, and we must strongly recommend a stricter adherence to the intent of this Act."

CAUSE OF THE DISASTER.

The coal mines of this district, which are locally known as the Pass mines, derive this distinction as being situated in the Crowsnest pass, in the southern part of the Province of Alberta, and adjoining part of the Province of British Columbia. The seams of coal have several characteristics which require special consideration, in reference to the method of extracting the coal in the underground workings.

(1) The seams of coal are all located in mountainous districts, hence are subject to very heavy pressure from the strata overlying the coal worked; (2) they have a great thickness between the roof and pavement, and (3) lie at high angles of inclination. These three characteristics constitute dangerous conditions in mining, which have to be guarded against not only at the present time, but more particularly in the future, as the underground workings go deeper from the surface; as the area of the workings become wider in extent, and the trade demands necessitate increasingly greater outputs of coal from the existing mines.

Explosions in coal mines may be classed under three general heads:—

(1) Explosions of gas;
(2) Explosions of coal dust; and
(3) Explosions of gas and coal dust combined.

It was brought out in evidence at the inquest, that two of the above-mentioned factors were involved in the explosion at the Bellevue mine: namely, explosive gas, which had been detected on the safety lamps of Cardel and Boveio, the men who had been sent by pit-boss Anderson to make an examination of the old workings after the first explosion; or, coal dust. The main point that had to be determined by the jury was: what caused the ignition of either the inflammable gas, or the coal dust, or a combination of these two factors. Two possible causes might be assigned: (1) A shot fired in the working faces; but this can be set aside, because all the men who were in the working faces gave evidence that the explosion came from the older section of the workings, where the force of the explosion was concentrated in the district from 50 to 80 chutes. (2) That a defective safety lamp might have ignited a body of explosive gas; but there was no evidence from which to draw the deduction that any of the lamps found had been tampered with or injured.

It is clearly demonstrated that the destructive zone of the explosion was at 75 or 76 chute. That an explosion of gas had occurred was demonstrated by the large amount of carbon monoxide gas and after-damp, encountered by the exploration party, at this section of the main gangway, and also that 3 of the 4 bodies recovered between 53 and 54 were burnt.

One important point that did not come out in the evidence was, that a strata of rock situated in the roof immediately over the coal is composed of a coarse-grained sandstone, highly impregnated with ironstone, so that when two small pieces are struck together vivid sparks are emitted at an intense heat.

It is affirmed that matches, pipes, and tobacco were found on one of the bodies recovered from between 53-54 chute, but this allegation was, by common consent, declared to have no bearing on the explosion.

The theory that I would suggest as being the probable cause of the disaster, is as follows:—

It is known that a very large cave-in of rock from the roof occurred in the vicinity of 70 to 78 chutes. The rubbing and grinding of the rocks, as they fell, emitted sparks at a high temperature. The heat generated by the friction and concussion of rocks raised the temperature of the air and gas to a high point, so that it would require only a spark of comparatively low thermal intensity to reach the ignition point of a small volume of hot explosive gas.[1] That the defective state of ventilation in the old workings was favourable to explosive conditions was manifest: for the ventilation was by scales of air through the board stoppings on the main gangway, and not by direct current, hence the air was in a sluggish condition, consequently when the explosion occurred, would give out a large volume of carbon monoxide gas without a large demonstration of explosive force. The force of the explosion travelled along the upper section of the workings, killing the 4 men working at the top of Nos. 52 and 53 chute; and the volume of carbon monoxide being forced down on the main gangway by the blowing out of the air stoppings evidently caused the death, by carbon monoxide poisoning, of the men who were on the main gangway.

If this deduction from the evidence, as submitted at the inquest is correct, then the finding of the corner's jury, that the 31 deaths were "caused by a cave-in of rock," is manifestly erroneous.

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[1]The following extract from evidence taken before the Royal British Commission on Electricity in Mines, bears out the above theory:—

Evidence given before the Departmental Committee, by Mr. Afred Onions, miners' agent and general treasurer, South Wales Federation:—

> Witness gave two instances where there had actually been explosions with nobody in the pit.
> One was at the Maindy colliery in the Rhondda valley.
> It was proved that there was absolutely no one in the pit. But when they went in on Monday morning, or Sunday night, they found evidence of a very violent explosion. The theory was that there had been a fall of roof, and then a further fall took place, the right composition of gas having accumulated in the meantime, and this other fall which was a fall of stone, brought down gas, and due to the fall there was sparking. This sparking ignited the gas. There was evidence of burning. There was another instance of an explosion occurring in a disused level at Pentre, in the Rhondda valley. There was no one in the place, and there was evidence of violent explosion. If his memory served him rightly, some of the stone that fell from the roof of the Maindy colliery was taken out and experimented upon by Mr. Heppell, of Cwmammau, in the Aberdare valley, and by some mechanical means he produced explosions by the sparking of this very stone.
>
> Then there was another instance of a man—he thought it was at the National Colliery—who was in a cutting, who struck his pick, or mandrel, as they call it in South Wales, against one of the stones in the coal, and sparking took place, and there was an explosion, because gas was present.
>
> So there was no doubt about it, if they had the right ingredients present, and the righ intensity of sparking. The cases were well authenticated. (The Colliery Guardian, June 16, 1911, page 1,206).

METHOD OF MINING.

The coal seams in this district lie at a high angle of inclination, and in the majority of cases the mines are slope or gangway openings, these openings having been commenced from a point where the seam outcrops to the surface.

The general practice is to drive a gangway and counter gangway on a slight rise, giving a sufficient inclination to allow water to flow outwards to the mine mouth.

The system of working the coal is to drive chutes (having 50 or 60 ft. centres) on the full pitch of the seam, and to run the coal down on the chutes to the main gangway, where it is loaded on the mine cars. All mining laws specify that there shall be two distinct exits from the mine; but in the case of the Bellevue Mine lay-out, there is only one way of exit, namely, along the main haulage gangway. Practically, the counter gangway is stopped by the coal chutes coming down, and through them at right angles, hence is not available for a travelling way out of the mine. Although from the main gangway Nos. 26, 45, and 81 chutes are put through to the surface, there was not any evidence submitted at the inquest to show that any of the men who survived the shock of the explosion, and they were by far the greater number, made the slightest attempt to escape from the mine by travelling up the exceedingly steep chutes to the surface—the rise being from 45 to 80 degrees. It is manifest, therefore, that some provision should be made for maintaining an upper level at the top of the chutes, which would serve a double purpose, namely, as a return air-way, and at the same time a travelling way in case of accident. This way of getting out of the mine in case of emergency, instead of by the main haulage gangway, would undoubtedly be a great advantage.

GENERAL DEDUCTIONS.

More Mine Inspectors Needed.

The first rider attached to the jury's verdict, viz., "That more mine inspectors should be appointed," is a wise suggestion, for there is sufficient work for a resident mine inspector in the pass inasmuch as the mines of this district can be classed as dangerous. Their future development will add many complex conditions to mining, and consequently will affect the safety of underground workers employed in the mines.

On the Establishment of Oxygen Breathing Apparatus Stations in Coal Mining Districts.

Unfortunately, the general public have conceived a very erroneous idea as to this class of apparatus. In the first place, by applying the word "rescue" as a prefix; the prevailing notion being, that any person can put himself into an oxygen breathing helmet to enter a mine after an explosion, and bring out the men. Such is not the case. The value of oxygen breathing, and the success of the apparatus, depends wholly on the physical organization of the men who go into a mine after an explosion, equipped with oxygen breathing apparatus.

Unless they are physically fit, and properly trained they only endanger their own lives, and do not accomplish any good purpose.

Mr. W. E. Garforth, Past-President of the Mining Association of Great Britain —a mining engineer with wide experience in the recovery of mines after explosion— says:—

"That unless the wearer of the apparatus has systematically and regularly practised for three months in a gallery on the surface made like the damaged roadway of a mine, with confined spaces, etc., and has been surrounded with an irrespirable, hot, and occasionally humid atmosphere, for at least two consecutive hours, then such an apparatus, instead of being a help to the wearer, may prove to be a 'Death Trap.'"

With regard to the establishment of oxygen-breathing rescue stations, the general opinion seems to be that, either the Dominion or Provincial Governments should be responsible for their instruction and maintenance. Perhaps the most satisfactory results will be obtained by the different coal companies in mining districts in the establishment of a series of strategic stations, co-operating and maintaining these stations, as a first-class insurance asset.

In order to make such a system efficient and effective, a committee should be formed, comprising inspector of mines, and representatives of both coal operators and mines employes, who will determine the most suitable location for a central station in the district, and sub-station at each separate mine. A competent officer in charge would be held responsible for the training of the men; keeping the apparatus in good condition, and maintaining a sufficient quantity of oxygen at the station and sub-station.

Each mine to have a specified number of trained men, based on the total number of men employed underground.

The respective coal companies to contribute to a general fund, assessed on the number of tons of coal mined. From this fund the apparatus will be purchased, installed, and maintained.

The various Provincial Governments to issue certificates of competency, and provide a distinctive badge for qualified men.

PROPOSED TELEPHONE SYSTEM.

Telephone communication should be established in all underground workings: not only facilitating communication in case of accident, but for the more efficient carrying out of the daily work.

EMERGENCY ACCESS TO MINE PLANS.

At the Bellevue mine the plans showing the underground workings were not up to standard which should be maintained in good mining practice. The blue-prints of the plans produced at the Coroner's inquest were not only lacking in many technical essentials but were proved to be inaccurate. They did not show any definite system of ventilation, nor were they available to the mine managers from surrounding collieries, who had rushed to the mine to render assistance and advice.

These mine plans should be available for inspection at the mine office, in the event of an accident such as occurred at the Bellevue mine. They should be kept up, and corrected to periods of every three months; show distinctly all roads then open, ventilation intakes, and return air-ways, in separate colours; and have marked thereon in plain lettering all main roads and chutes or gate roads; the position of overcasts, ventilating doors, the air splits, also the quantity and direction of the air currents with the position of the ventilating fan. In cases where the ventilating fan has been reversed, there should be provided, if possible, a duplicate plan showing the above details. On the plan should be carefully indicated the position of the sections where men are at the working faces; these plans should be kept in an emergency drawer, conspicuously marked.

MINES REGULATION ACT.

The last rider attached to the verdict of the Coroner's jury has a very important bearing on this special disaster since it attached blame on all concerned. "It declares that negligence is in evidence on the part of the operators and miners in the carrying out of the Coal Mines Act, and we would most strongly recommend a stricter adherence to the intent of the Act."

The coal mining industry of the Province of Alberta is passing through the same experience in relation to coal mining, as other countries; sacrificing life and limb to the exigencies of output.

The coal-fields of Alberta have been developed very rapidly. In the year 1900, the annual production of coal was 311,450 tons; for the year 1909, the output was 1,994,741, and the estimated production for the year 1910 is 3,000,000. This large increase of tonnage has naturally made a heavy demand for miners, and other mine workers, generally. There has been a great striving by the mine operators to meet tonnage demands.

A large number of new mines have been opened, and in existing mines extended areas have been developed. These strenuous conditions have doubtless had not a little to do with the increasing number of mining accidents, as the following tabulated statistics will show:—

Comparative Statement of Accidents in Coal Mines, 1905-1910.

Year.	Alberta: number of men employed.	Alberta: accidents.			Alberta: ratio per 1,000 men employed.			British Columbia: number of men employed.	British Columbia: accidents.			British Columbia: ratio per 1,000 men employed.			Nova Scotia: number of men employed.	Nova Scotia: accidents.			Nova Scotia: ratio per 1,000 men employed			Great Britain: fatal accidents, per 1,000 men employed.	United States: fatal accidents, per 1,000 men employed.
		Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.		Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.		Fatal.	Serious.	Slight.	Fatal.	Serious.	Slight.		
1905	2,800	15	18	*	5·35	6·43	.....	4,407	12	30	26	2·72	7·03	5·90	10,780	20	55	19	1·85	5·10	1·76	1·38	3·53
1906	2,800	10	31	*	3·57	11·07	.....	4,805	15	36	32	3·12	7·49	6·66	12,123	29	58	16	2·30	4·79	1·32	1·29	3·40
1907	3,600	19	86	*	5·27	23·88	.....	6,059	31	61	62	5·11	10·06	10·23	12,107	37	59	22	3·05	4·87	1·81	1·32	4·86
1908	3,780	11	51	*	2·91	16·14	...	6,095	18	50	52	2·95	8·20	8·53	12,933	45	97	82	3·48	7·50	6·34	1·32	3·55
1909	5,207	9	60	*	1·72	11·52	...	6,418	57	47	59	8·88	7·32	9·19	12,083	35	68	8	3·89	5·62	0·66	1·43	3·76
1910	5,818	61	41	58	10·48	7·04	9·97	7,758	28	95	66	3·61	12·24	8·51	10,970	31	80	75	2·82	7·30	6·83	1·69	
	24,005	125	287	58	5·20	13·52	9·97	35,542	161	319	297	4·53	8·97	8·35	70,996	197	417	222	2·77	5·87	3·12	1·40	3·82

In the year 1910 there were 61 fatal accidents in the coal mines, Province of Alberta: 59 inside and 2 outside of the mines; as against a total of 9 for the year 1907. The Bellevue Mine disaster on the 9th of December, 1910, contributed 31 deaths of the 61 total.

In the year 1909 the death rate of 8·88 per 1,000 men employed in the coal mines of British Columbia was the highest rate for Canada, or the United States. For the year 1910, the high death rate of 10·18 per 1,000 men employed in the coal mines of Alberta, will probably place this Province in that position.

*Accidents serious and slight not separated in Government returns.

J. G. S. Hudson.

MAPPING AND DRAUGHTING DIVISION.

Maps and Drawings.

MAGNETOMETRIC SURVEY MAPS:—

Bristol Mine.—Prepared by E. Lindeman; completed and traced for reproduction, by L. H. S. Pereira.

Northeast Arm Timagami Lake.—Drawn by E. Lindeman; traced for reproduction by L. H. S. Pereira.

Maps for Dr. A. W. G. Wilson's Report on the Copper Mining Industry of Canada:—

Route map of Eastern Canada and United States.
Map of Quebec district.
Map of British Columbia.
Map of Nova Scotia.
Map of Parry Sound district.
Prepared and traced for reproduction by A. Pereira.
Map of Eustis Mine, Province of Quebec.
Prepared and plotted by Howells Fréchette, assisted by A. Pereira.

Diagram of Hull Explosion for J. G. S. Hudson's Report:—
Prepared by H. Fréchette; redrawn by L. H. S. Pereira.

Plan of Dominion Coal Company's Coal Areas:—
Making corrections and additions on original tracing of same. Also colouring three copies of black and white prints, by A. Pereira.

Illustrations for Bulletin No. 3, Recent Advances in the Construction of Electric Furnaces, by Eugene Haanel, Ph.D.:—
Fifteen drawings of Experimental Furnace; traced for reproduction by L. H. S. Pereira.

Working Drawings for Ore Dressing and Concentrating Laboratory—G. C. Mackenzie:—
Working drawings for Box Feeder; and
Working drawings for Separating Tanks for Fuel Testing Plant, Ottawa, by L. H. S. Pereira.

Drawings to Accompany Peat Bulletin No. 4, by A. Anrep, Jr.:—
Map of Brunner Peat Bog, Ontario.
Map of Komoka Peat Bog, Ontario.
Map of Rondeau Peat Bog, Ontario.
Map of Brockville Peat Bog, Ontario.

Plan of Government Peat Bog, Alfred, Ontario: showing contours.
Plan of Government Peat Bog, Alfred, Ontario: showing layout.
Plan of Government Peat Plant, Alfred, Ontario.
Profile of Main Ditch.

Working Drawings:—
Drawings of Peat Sheds, Front and Side Elevations.
Drawings of Four Buildings at Alfred Peat Bog.
Drawings of Side Dump Car for Dried Peat.
Diagram of Wet-Carbonizing Oven.
Drawing of Rail Section.

All prepared in the rough by A. Anrep, jr., finished and traced for reproduction by L. H. S. Pereira.

Reproduction of Drawings for Report on the Gypsum Deposits of the Maritime Provinces, by W. F. Jennison, M.E.:—

Map of Magdalen Islands, showing Gypsum Deposits.
Map of Nova Scotia, " " "
Map of New Brunswick, " " "
Plan for 32″ × 96″ Kettle Plaster Mill.
Plan and Section for 32″×96″ Kettle Plaster Mill.
Plan for 32″×120″ " " "
Sections for 32″×120″ " " "
Sections for 32″×96″ " " "
Plan and Section for 32″×120″ " " "
" " 18″×72″ " " "
Elevations and Sections 18″×72″ " " "
Side Elevation of Cummer Calcining Plant.
End Elevation " " " "
Plan " " " "
General Layout of Great Northern Mining Company's Gypsum Mill.
Elevation of Plaster Mill, Great Northern Mining Co.
Section through Gypsum Deposit, Great Northern Mining Co.
Section of Borehole in Cheverie Gypsiferous Area.
Construction of Fireproof Walls, U. S. Gypsum Co., Ltd.
Plan and Section of Olson Land Plaster Distributor.
Bottom and Inside View " " "

REPORT OF EDITORIAL OFFICE.

Reports, Bulletins, Etc., Published Since January 1, 1910.

47. Iron Ore Deposits of Vancouver and Texada Islands—by E. Lindeman, M.E. Published March 14, 1910.
55. Report on the Bituminous or Oil-shales of New Brunswick and Nova Scotia; also on the Oil-shale Industry of Scotland—by Dr. R. W. Ells. Published February 24, 1910.
58. Annual Report of Division of Mineral Resources and Statistics on the Mineral Production of Canada during the calendar years 1907 and 1908—by J. McLeish, B.A. Published May 16, 1910.
59. Report on Chemical Analyses made in the Mines Branch Laboratories during the years 1906, 1907, and 1908. (Appendix—Commercial Methods and Apparatus for the Analysis of Oil-shales—by H. A. Leverin). By F. G. Wait. Published August 27, 1910.
62. Preliminary Report on the Mineral Production of Canada during the Calendar year, 1909—by J. McLeish, B.A. Published March 1, 1910.
63. Summary Report, 1909. Published July 31, 1910.
67. Bulletin No. 2: Iron Ore Deposits of the Bristol Mine, Pontiac county, Que.—by E. Lindeman, M.E., and G. C. Mackenzie, B.Sc. Published June 29, 1910.
68. Bulletin No. 3: Recent Advances in the Construction of Electric Furnaces for the Production of Pig Iron, Steel, and Zinc—by Eugene Haanel, Ph.D. Published September 13, 1910.
69. Chrysotile-Asbestos: Its Occurrence, Exploitation, Milling, and Uses (Second Edition)—by Fritz Cirkel, M.E. Published March 30, 1911.
71. Bulletin No. 4: Investigation of the Peat Bogs, and Peat Industry of Canada, 1909-10, by Aleph Anrep: to which is appended Mr. Alf. Larson's paper on Dr. M. Ekenberg's Wet-Carbonizing Process, from Teknisk Tidskrift, No. 12, December 26, 1908. Translation by Mr. A. Anrep, Jr.; also a translation of Lieut. Ekelund's Pamphlet, entitled "A Solution of the Peat Problem," 1909, describing the Ekelund Process for the Manufacture of Peat Powder—by Harold A Leverin, Ch.E. (Second Edition enlarged). Published December 7, 1910.
79. Production of Iron and Steel in Canada during the calendar year 1909—by J. McLeish, B.A. Published December 12, 1910.
80. Production of Coal and Coke in Canada during the calendar year 1909—by J. McLeish, B.A. Published December 14, 1910.
82. Bulletin No. 5: Magnetic Concentration Experiments with Iron Ores of the Bristol Mines, Que.; Iron Ores of the Bathurst Mines, N.B.; a Copper Nickel Ore, from Nairn, Ont.—by G. C. Mackenzie, B.Sc. Published February 10, 1910.

85. Production of Cement, Lime, Clay Products, Stone, and Other Structural Materials, in Canada, during the calendar year 1909—by J. McLeish, B.A. Published December 24, 1910.

88. Annual Report of the Division of Mineral Resources and Statistics on the Mineral Production of Canada, during the calendar year 1909—by John McLeish, B.A. Published July 18, 1911.

89. Proceedings of Conference on Proposed Legislation on the Manufacture, Importation, and Testing of Explosives: Held House of Commons, Sept. 23, 1910—by Eugene Haanel, Ph.D. First Edition published September 28, Second Edition published January 31, 1910.

92. Investigation of the Explosives Industry in the Dominion of Canada, 1910—by Capt. Arthur Desborough. First Edition published February 10, 1911, Second Edition published June 14, 1911.

102. Preliminary Report on the Mineral Production of Canada for the calendar year 1910—by J. McLeish, B. A. Published February 28, 1911.

ACCOUNTANT'S STATEMENT.

MINES BRANCH.

Statement of Appropriation and Expenditure by Mines Branch for the year ending March 31, 1910:—

	Appropriation.	Expenditure.
	$ cts.	$ cts.
Amount voted by Parliament	112,937 50	
Amount received for assays and analyses	366 15	
Civil list salaries		27,618 51
Machinery, labour, etc., Peat bog, Alfred		11,529 17
Publication of reports and maps		8,686 60
Coal tests		6,000 00
Fuel testing plant, Ottawa		5,640 04
Investigations, etc., peat and coals		5,151 49
Monograph on gypsum		4,429 76
Investigations *re* iron ores		3,940 70
Printing, stationery, and mapping materials		3,007 02
Monograph on asbestos		2,850 02
Laboratory		2,144 08
Wages		1,720 34
Mining and metallurgical industries		1,611 54
Investigations of copper deposits		1,218 13
Instruments		899 49
Postages and telegrams		559 22
Travelling expenses		333 50
Miscellaneous		290 96
Books and periodicals		211 17
J. E. Woodman, advance unaccounted for		100 00
Balance unexpended and lapsed		25,361 91
	113,303 65	113,303 65

(Signed) **John Marshall,**

Accountant Department of Mines.

APPENDIX I.

Preliminary Report on the Mineral Production of Canada, During the Calendar Year 1910: With Revised Statistics for 1909.[1]

Eugene Haanel, Ph.D.,
Director of Mines.

Sir:—I beg to submit herewith, the annual preliminary report on the mineral production of Canada in 1910, including a table showing the revised statistics of production in 1909.

The figures of production given for 1910 are, of necessity, subject to revision, since at this time, in many instances, producers of metallic ores have not themselves received complete returns from smelters. For these and other reasons, estimates have to be made. It is hoped, however, that this preliminary statement may serve to give a general idea of the gross output of the mineral industry during the year.

I am, Sir, your obedient servant,
(Signed) **John McLeish.**

Division of Mineral Resources and Statistics,
February 23, 1911.

THE MINERAL PRODUCTION OF CANADA, 1910

(Statistics subject to revision.)

Although complete statistics are not yet available, sufficient information is at hand to indicate that the total value of the mineral production of Canada during the past year exceeded $105,000,000. This production is made up from such a great variety of well established mining industries that the record should be particularly gratifying not only to those who are directly interested in the development of the mineral resources of the country, but also to the public at large who indirectly profit thereby.

Not only is the increase over the production of the previous year a large one, having amounted to $13,209,517, or over 14 per cent, but an examination of the details of production shows that the increase has been fairly well distributed amongst the more important ores and minerals produced in Canada.

The production of the more important metals and minerals is shown in the following tabulated statement in which the figures are given for the two years, 1909 and 1910, in comparative form, and the increase or decrease in value shown. Tabulated statements for both years, in greater detail, will be found on subsequent pages of this pamphlet:—

	1909.		1910.		Increase (+) or decrease (—) in value.
	Quantity.	Value.	Quantity.	Value.	
		$		$	$
Copper.....Lbs.	52,493,863	6,814,754	56,598,074	7,209,463	+ 394,709
Gold.....Ozs.	453,865	9,382,230	.....	10,224,910	+ 842,680
Pig iron.....Tons.	757,162	9,581,864	800,797	11,245,630	+ 1,663,766
Lead.....Lbs.	45,857,424	1,692,139	32,987,508	1,237,032	— 455,107
Nickel..... "	26,282,991	9,461,877	37,271,033	11,181,310	+ 1,719,433
Silver.....Ozs.	27,529,473	14,178,504	31,983,328	17,106,604	+ 2,928,100
Other metallic products....	.....	405,122	.....	559,186	+ 154,064
Total.....	.....	51,516,490	.....	58,764,135	+ 7,247,645
Less pig iron credited to imported ores.....	607,718	7,359,649	695,891	9,594,309	+ 2,234,660
Total metallic.....	.....	44,156,841	.....	49,169,826	+ 5,012,985
Asbestos and asbestic.Tons.	87,300	2,201,775	100,385	2,476,558	+ 274,783
Coal..... "	10,501,475	24,781,236	12,796,512	29,811,750	+ 5,030,514
Gypsum..... "	439,129	809,632	531,313	939,838	+ 130,206
Natural gas.....	.....	1,207,029	.....	1,312,614	+ 105,585
Petroleum.....Bls.	420,755	559,604	315,895	388,550	— 171,054
Salt.....Tons.	84,037	415,219	84,029	409,624	— 5,595
Cement.....Bls.	4,067,709	5,345,802	4,753,975	6,414,315	+ 1,068,513
Clay products.....	.....	6,450,810	.....	7,600,000	+ 1,149,190
Lime.....Bus.	5,592,924	1,132,756	5,721,285	1,131,407	— 1,349
Stone.....	.....	3,127,135	.....	3,499,772	+ 372,637
Miscellaneous non-metallic.	.....	1,642,602	.....	1,886,704	+ 244,102
Total non-metallic.....	.....	47,674,600	.....	55,871,132	+ 8,196,532
Grand total.....	.....	91,831,441	.....	105,040,958	+13,209,517

The subdivision of the mineral production in 1909 and 1910 by provinces was approximately as follows:—

Province.	1909.		1910.	
	Value.	Per cent of total.	Value.	Per cent of total.
	$		$	
Nova Scotia	12,504,810	13·62	14,054,534	13·38
New Brunswick	657,035	0·71	585,891	0·56
Quebec	7,086,265	7·72	8,193,275	7·80
Ontario	37,374,577	40·70	43,017,026	40·95
Manitoba	1,193,377	1·30	1,470,776	1·40
Saskatchewan	456,246	0·50	557,806	0·53
Alberta	6,047,447	6·58	7,876,458	7·50
British Columbia	22,479,006	24·48	24,547,817	23·37
Yukon	4,032,678	4·39	4,737,375	4·51
	91,831,441	100·00	105,040,958	100·00

It will be observed that there has been an increased production in nearly every province, the only falling off being shown by New Brunswick, in which the gypsum production, and some of the structural products, showed a slight decrease.

In Nova Scotia there was a largely increased productior of coal and gypsum. In Quebec the principal increases were in cement and asbestos. Ontario's increases are principally in the metals, copper, nickel, and silver.

Manitoba shows an increased production of gypsum and clay products; while in Alberta clay products, cement, and particularly coal, contribute the chief gains. In British Columbia the increase is mainly due to the coal industry, while the Yukon not only shows a gratifying gain in gold production but a growing shipment of copper and silver ores.

Of the total production in 1910, $49,169,826 or 46·8 per cent is credited to the metals, and $55,871,132 or 53·2 per cent to the non-metallic products. Amongst the individual products, coal still contributes the greatest value, constituting 28·4 per cent of the total. Silver is next with about 16·3 per cent; nickel, third with 10·6 per cent; gold, 9·7 per cent; clay products, 7·2 per cent; copper, 6·8 per cent, and cement, 6·1 per cent.

In valuing the metallic production, the same general practice has been followed as in past years, with one or two slight modifications. Instead of valuing lead at the New York price, the average price at Toronto has been used. This is somewhat lower than the New York price, but higher than that in London.

Nickel has been valued at an average price of 30 cents per pound, although the minimum quotation for the metal in large lots was 40 cents. Considerable quantities of monel metal are now made, the production of which does not require the separation of the nickel metal, and the price of 30 cents is equivalent to valuing two-thirds of the production at 37½ cents, and one-third at 15 cents.

THE MINERAL PRODUCTION OF CANADA IN 1910.

(Subject to revision).

Product.		Quantity.	Value.
	METALLIC.		$
Copper, value at 12·738 cents per pound	Lbs.	56,598,074	7,209,463
Gold			10,224,910
Pig iron from Canadian ore	Tons.	104,906	1,651,321
Iron ore (exports)	"	114,449	324,186
Lead, value at 3·75 cents per pound	Lbs.	32,987,508	1,237,032
Nickel, value at 30 cents per pound	"	37,271,033	11,181,310
Silver, value at 53·486 cents per ounce	Ozs.	31,983,328	17,106,604
Zinc ore and other products			235,000
Total			49,169,826
	NON-METALLIC.		
Arsenic, white	Tons.	1,502	75,328
Asbestos	"	75,678	2,458,929
Asbestic	"	24,707	17,629
Coal	"	12,796,512	29,811,750
Corundum	"	1,870	198,680
Feldspar	"	15,719	47,867
Fluorspar	"	2	15
Graphite	"	1,243	59,087
Grindstones	"	3,847	43,936
Gypsum	"	513,313	939,838
Magnesite (railway shipments)	"	328	2,493
Mica	"		143,409
Ochres	"	4,813	33,185
Mineral water			175,173
Natural gas			1,312,614
Peat	Tons.	771	1,735
Petroleum, value at $1·23 per barrel	Bls.	315,895	388,550
Phosphate	Tons.	1,319	11,780
Pyrites	"	55,925	192,263
Quartz	"	88,205	91,951
Salt	"	84,092	409,624
Talc	"	7,112	22,308
Tripolite	"	22	134
Total			36,438,278
	STRUCTURAL MATERIAL AND CLAY PRODUCTS.		
Cement, Portland	Bls.	4,753,975	6,414,315
Clay products—			
Brick			5,930,630
Sewer-pipe, fireclay, drain tile, pottery, etc			1,669,370
Lime	Bus.	5,721,285	1,131,407
Sand and gravel (exports)	Tons.	624,824	407,974
Sand-lime brick			360,894
Slate			18,492
Stone—			
Granite			634,783
Limestone			2,303,804
Marble			158,779
Sandstone			402,406
Total structural materials and clay products			19,432,854
All other non-metallic			36,438,278
Total value, metallic			49,169,826
Total value, 1910			105,040,958

The average monthly prices [1] of the metals in cents per pound for several years past are shown herewith:—

——	1906.	1907.	1908.	1909.	1910.
	Cts.	Cts.	Cts.	Cts.	Cts.
Copper, New York	19·278	20·004	13·208	12·982	12·738
Lead, "	5·657	5·325	4·200	4·273	4·446
" Toronto	4·727	5·429	3·894	3·692	3·750
Nickel, New York	41·64	45·000	43·000	40·000	40·000
Silver, "	66·791	65·327	52·864	51·503	53·486
Spelter, "	6·198	5·962	4·720	5·503	5·520
Tin, "	39·819	38·166	29·465	29·725	34·123

[1] Quotations from *Hardware and Metal* and *Engineering and Mining Journal.*

Smelter Production.

General statistics of smelter production were collected by this branch for the first time in 1908, and the aggregate results of these operations during the years 1908 and 1909 are shown in the accompanying table. Unfortunately, complete returns have not yet been received for the year 1910. It should be explained also that the figures include the results of the treatment of a small quantity of imported ores. The results of the operations at the smelter at Northport, Wash., treating chiefly Canadian ores, have also been included:—

SMELTER AND REFINERY PRODUCTION IN CANADA, 1908 AND 1909.

——		1908.		1909.	
		Refined products.	Metals contained in matte, blister, base bullion, and speiss.	Refined products.	Metals contained in matte, blister, base bullion, and speiss.
Antimony	Lbs.	.....	.....	61,207	
Gold	Ozs.	15,436	203,300	18,241	200,129
Silver	"	11,168,689	3,271,899	14,242,545	4,845,920
Lead	Lbs.	36,549,274	1,116,792	41,883,614	3,973,810
Copper	"	.....	51,965,289	.....	53,328,583
Copper sulphate	"	203,379	.....	51,405	
Nickel	"	.....	19,506,251	.....	27,041,957
Cobalt	"	.....	692,170	.....	1,321,083
White arsenic	"	1,431,052	.....	2,258,087	
Arsenic	"	.....	436,787	.....	1,074,516

The total ore charged to the furnaces during each of the past three years is shown as under:—

—	1908.	1909.	1910.
Nickel-copper ores	360,180	462,336	628,947
Silver-cobalt-nickel-arsenic ores	7,182	8,384	9,466
Lead and other ores treated in lead furnaces	53,545	53,006	57,547
Copper-gold-silver ores	1,797,488	1,850,889	*2,000,000
Total	2,218,395	2,374,615	2,695,960

*Returns incomplete but tonnage probably exceeded the figure given.

Gold.

While statistics of gold production are as yet incomplete, a preliminary estimate shows a production of approximately $10,224,910, an increase of about 9 per cent over the 1909 production. The production of the Yukon is valued at $4,550,000, the total exports on which royalty was paid during the calendar year according to the records of the Interior Department being 275,472·51 ounces. The Yukon production in 1909 was $3,960,000, the exports being 239,766·35 ounces. The British Columbia production in 1909 was: placer gold $477,000; bullion from free milling ores $329,655; smelter recoveries $4,367,924. In 1910 the placer production is estimated by the Provincial Mineralogist as $482,000. An estimate of free milling bullion shipments and smelter recoveries is made of $4,950,000, or a total production for the Province of $5,432,000. The Nova Scotia production shows a falling off of about $20,000, while Ontario will probably show a slight increase on account of the gold recovered in development work at Porcupine, of which a re ord has not yet been received.

Silver.

The silver production of Canada in 1909 showed an increase of 24·5 per cent over that of 1908 following a series of large increases during the three preceding years. It is very satisfactory, therefore, to be able to report a further increase in 1910 of about 16 per cent. The total production last year, including that produced as bullion and the metal estimated as recovered from ores sent to smelters or otherwise treated, was approximately 31,983,328 ounces, as compared with a production of 27,529,473 ounces in 1909.

The increase is again chiefly credited to Cobalt and adjacent mining districts of Ontario.

There was a slight falling off in the silver production of British Columbia as a result of the decreased production from the silver lead ores of the Province.

For the Province of Ontario, complete returns have been received from all the larger operators, while estimates based on railway shpiments have been made for two or three of the smaller mines. The net production of recoverable silver is estimated at 29,375,000 ounces, that is after deducting 5 per cent from the settlement assays of ores sent to smelters to allow for smelting losses. At the average price of silver for the year this has a value of $15,711,513.

The production similarly estimated for 1909 was 24,822,099 ounces, thus showing an increase in 1910 of about 4,552,901 ounces, or over 18 per cent.

The total shipments of ore and concentrates were about 34,580 tons, containing approximately 29,931,678 ounces of silver, in addition to which somewhat over 940,000 ounces were shipped as bullion. The average silver content of ore and concentrates shipped was thus about 865·57 ounces, or $462.96 per ton, as compared with an average of 840 ounces in 1909.

The shipments during 1909 were 27,835 tons of ore, containing 22,349,717 ounces of silver, or an average of 803 ounces per ton; 3,059 tons of concentrates containing 3,627,819 ounces, or an average of 1,186 ounces per ton, and bullion containing 143,440 fine ounces.

The exports of silver in ore, etc., as reported by the Customs Department, were 30,699,770 ounces, valued at $15,649,537.

The price of refined silver in New York varied between a minimum of 50½ cents per ounce on March 2, and a maximum of 56¾ cents on October 19, the average monthly price being 53·486, as compared with an average monthly price of 51·503 cents in 1909.

Copper.

No refined copper is produced in Canada, but the copper ores are mostly reduced to a matte or blister copper carrying values in the precious metals. In Quebec, where the copper is recovered subsequently to the extraction of the sulphur from pyritic ores, there was increased activity during the year. A small quantity of ore was exported from British Columbia coast mines and the Yukon to United States smelters for treatment. In Ontario, where the copper is chiefly recovered from the nickel-copper ores of the Sudbury district, there is a very large increase in production. In British Columbia the most important events during the year were the acquisition of a controlling interest in the Dominion Copper Company by the British Columbia Copper Company, with the subsequent re-opening of several of the properties, and the destruction by fire of part of the head works of the Granby mines at Phœnix, B.C., which noticeably affected the output, although the Boundary district as a whole shows an increased production.

Statistics are not available at the present time to show the total quantity of copper contained in ores shipped from the mines. The total production of copper, however, contained in blister and matte produced and estimated as recoverable from ores exported, was in 1910 approximately 56,598,074 pounds. In 1909 the production of copper estimated on the same basis was 52,493,863 pounds, an increased production of about 7·8 per cent being, therefore, shown in 1910.

Of the production in 1910, Quebec is credited with 957,178 pounds; the production in Ontario was 19,259,016 pounds; and in British Columbia the production

is estimated at about 36,000,000 pounds. Ontario shows an increased production of about 3,512,317 pounds, or 22·3 per cent, while British Columbia shows a slight increase, the production in 1909 being estimated at 35,658,952 pounds.

The New York price of electrolytic copper during the year varied between the limits of 12 cents and 13¾ cents per pound, the average being 12·738, as compared with an average of 12·982 cents in 1909.

The total exports of copper contained in ore, matte, and blister, according to Customs Department returns, were 56,964,127 pounds, valued at $5,840,553. It will be noted that the exports agree very closely in number of pounds with the record of the production which would be expected since practically all the copper is exported.

Lead.

The total production in 1910 of pig and manufactured lead was 32,987,508 pounds, valued at the average price of refined lead in Toronto at $1,237,032.

The production of refined lead and lead contained in base bullion exported in 1909 was 45,857,424 pounds. A decreased production in 1910 is, therefore, shown of 12,869,916 pounds.

The production of both years was entirely from British Columbia. The falling off in the output of that Province is due largely to the curtailment of production by several of the important Slocan mines, resulting from the destruction of railway facilities and of several mines buildings by forest fires.

The Blue Bell mine also, one of the leading shippers of lead in 1909, suspended operations early in 1910. Against these decreases may be placed the advent of the Sullivan mine, East Kootenay, into the list of shippers.

The exports of lead in ore during the year were 23 tons, and of pig lead 3,856 tons, or a total of 3,879.

About 12,614 tons of domestic production were, therefore, available for home consumption.

The imports of lead in 1910 were 8,305 tons, valued at $525,265; in addition to which were manufactures valued at $107,688, and litharge, white and red lead, etc., $200,790, or a total value of $833,743.

The price of lead in Toronto during 1910 averaged about 3·750 cents per pound, in New York 4·446 cents per pound, and in London £12·920 per long ton.

The amount of bounty paid during the twelve months ending December 31, 1910, on account of lead production, was $318,308·28, as compared with a payment of $346,527·98 in 1909.

Nickel.

There has been a very large increase in the production of nickel-copper ores in Ontario during the past two years, and it is perhaps not generally realized that the production of nickel in this Province is now almost as large, pound for pound, as the production of copper in British Columbia, while the market price of the metal is from two to three times that of copper. A portion of the production is, however, now recovered with copper as monel metal and sold at a much lower

price than fine nickel. Active operations are being carried on by the same companies as formerly, viz.: the Mond Nickel Company, at Victoria Mines, and the Canadian Copper Company, at Copper Cliff.

The ore is first roasted and then smelted and converted to a Bessemer matte containing from 77 to 82 per cent of the combined metals, copper and nickel; the matte being shipped to the United States and Great Britain for refining.

The total production of matte in 1910 was 35,033 tons, valued at the furnace at $5,380,064, an increase of 9,188 tons, or 31·6 per cent over the production of 1909. The metallic contents were copper, 19,259,016 pounds, and nickel, 37,271,033 pounds.

The aggregate results of the operations on the Sudbury District nickel-copper ores during the past four years were as follows in tons of 2,000 pounds:—

——	1907.	1908.	1909.	1910.
Ore mined	351,916	409,551	451,892	652,392
Ore smelted	359,076	360,180	462,336	628,947
Bessemer matte produced	22,041	21,197	25,845	35,033
" shipped	22,025	21,210	.....	.....
Copper content of matte shipped	6,996	7,503	7,873	9,630
Nickel " " "	10,595	9,572	13,141	18,625
Spot value of matte shipped	$3,289,382	$2,930,989	$3,913,017	$5,380,064
Wages paid	$1,278,694	$1,286,265	$1,234,904	$1,748,153
Men employed	1,660	1,690	1,735	

Exports of nickel contained in ore, matte, etc., as compiled from Customs reports, have been, for the twelve months ending December 31, as follows:—

——	1906. Pounds.	1907. Pounds.	1908. Pounds.	1909. Pounds.	1910. Pounds.
To Great Britain	2,716,892	2,518,338	2,554,486	3,843,763	5,335,331
To United States	17,936,953	16,857,997	16,865,407	21,772,635	30,679,451
	20,653,845	19,376,335	19,419,893	25,616,398	36,014,782

The price of refined nickel in New York remained practically constant throughout the year—the quotation being "Large lots, contract business, 40 to 45 cents per pound. Retail spot from 50 cents for 500 pound lots up to 55 cents for 200 pound lots. The price for electrolytic is 5 cents higher."

Iron.

Iron Ore.—Excluding Quebec, for which complete returns have not been received, the production of iron ore in 1910 was 254,915 short tons, valued at $566,109. The shipments may be classified as magnetite, 124,535 tons, hematite, 130,380 tons. In 1909 the total shipments were 268,043 tons, valued at $659,316, and comprised magnetite, 74,240 tons, hematite, 190,473 tons, and bog ore, 3,330 tons.

Exports of iron ore from Canada during 1910 are recorded by the Customs Department as 114,499 tons, valued at $324,186. This is chiefly from Moose Mountain mine, Ontario, Torbrook, N.S., and Bathurst, N.B.

Although not a Canadian production, it may be of interest to state that the two Canadian companies operating the Wabana mines, shipped during the year 1,259,626 short tons: of which 808,762 tons were shipped to Sydney and 450,864 tons to the United States and Europe.

Pig Iron.—An increase of 5·58 per cent is shown in the production of pig iron in Canada in 1910 as compared with 1909. The total production in 1910 was 800,797 short tons, valued at $11,245,630, as compared with 757,162 tons, valued at $9,581,864, in 1909. These figures do not include the output from electric furnaces making ferro-products, which are situated at Welland and Sault Ste. Marie, Ont., and Buckingham, Que. Of the total output of pig iron during 1910, 17,164 tons valued at $333,956, or $19.78 per short ton, were made with charcoal as fuel, and 783,633 tons valued at $10,911,674, or $13.92 per ton, with coke. The amount of charcoal iron made in 1909 was 17,003 tons, and iron made with coke was 740,159 tons. The classification of the production of 1910, according to the purpose for which it was intended, was as follows: bessemer, 219,492 tons; basic, 425,400 tons; foundry, including miscellaneous, 138,741 tons.

The amount of Canadian ore used during 1910 was 160,290 tons; imported ore 1,406,668 tons; mill cinder, etc., 22,671 tons.

The amount of coke used during the year was 993,037 tons, comprising 499,717 tons from Canadian coal and 493,320 tons imported coke or coke made from imported coal.

The consumption of charcoal was 1,615,919 bushels.

Limestone flux was used to the extent of 569,355 tons.

In connexion with blast furnace operations there were employed 1,403 men, and $1,006,727 were paid in wages.

The total daily capacity of 16 completed furnaces was, according to returns received, 2,880 tons.

The number of furnaces in blast December 31, 1910, was 11.

The production of pig iron by provinces in 1909 and 1910 was as follows:—

Province.	1909.			1910.		
	Tons.	Value.	Per ton.	Tons.	Value.	Per ton.
		$	$ cts.		$	$ cts.
Nova Scotia	345,380	3,453,800	10 00	350,287	4,203,444	12 00
Quebec	4,770	125,623	26 34	3,237	85,256	26 34
Ontario	407,012	6,002,441	14 75	447,296	6,956,930	15 55
Total	757,162	9,581,864	12 65	800,797	11,245,630	14 04

The exports of pig iron during the year are reported as 9,763 tons, valued at $296,310. Probably the greater part of this is ferro-silicon and ferro-phosphorus, produced at Welland and Buckingham, respectively.

There were imported during the year 227,753 tons of pig iron, valued at $3,122,695; 16,106 tons of charcoal pig valued at $242,152, and 18,900 tons of ferro-manganese, valued at $464,741.

Steel.—The total production of ingots and castings in 1910 was approximately 822,281 short tons, of which 803,600 tons were ingots, and 18,681 tons were castings. The figures have been partially estimated, the records of the Ontario Iron and Steel Company having been unfortunately destroyed by fire. The production in 1909 was reported as 754,719 short tons, made up of 739,703 tons of ingots and 15,016 tons of castings.

Returns from seven of the principal rolling mills report the production in 1910 of steel in the following shapes: blooms and billets 635,500 short tons; rails 399,761 tons; rods and bars 214,233 tons; miscellaneous rolled products 23,167 tons.

Statistics showing the open-hearth and bessemer steel production for four years are as follows:—

	1907.	1908.	1909.	1910.
	Tons.	Tons.	Tons.	Tons.
Ingots—Open-hearth (basic)	459,240	443,442	535,988	580,932
Bessemer (acid)	225,989	135,557	203,715	222,668
Castings—Open-hearth	20,602	9,051	14,013	18,083
Other steels	1,151	713	1,003	598
Total	706,982	588,763	754,719	822,281

Iron and Steel Bounties.—Following is a statement of the bounties paid on iron and steel during the calendar years 1909 and 1910, as kindly furnished by the Trade and Commerce Department. As no bounty is paid on iron made from mill cinder or ingredients other than ore, the figures do not show the total output of the furnaces but only those quantities on which bounty was paid.

	1909.		1910.	
	Quantity on which bounty was paid.	Bounty.	Quantity on which bounty was paid.	Bounty.
	Tons.	$ cts.	Tons.	$ cts.
Pig iron made from Canadian ore	126,297·55	214,705 80	84,758·70	76,282 83
Pig iron made from imported ore	607,718·09	425,402 64	695,891·23	278,356 52
Total, pig iron	734,015·64	640,108 44	780,649·93	354,639 35
Steel ingots	729,189·37	766,470 41	767,379·39	460,427 64
Steel wire rods	81,405·42	488,432 70	88,179·58	529,077 60
Total bounty paid on iron and steel		1,895,011·55		1,344,144·59

Asbestos.

The total shipments of asbestos in 1910, with one firm still to hear from, are reported as 75,678 tons, valued at $2,458,929; as compared with 63,349 tons, valued at $2,284,587 in 1909, an increase of about 19 per cent in tonnage and 7·6 per cent in total value.

The number of men employed in mines and mills is reported as 3,443, at a wage cost of $1,393,856. While the shipments are reported as above, the actual production was returned as 4,815 tons of crude and 91,353 tons of mill stock produced from 1,474,527 tons of asbestos rock, or a total production of 96,168 tons; stock on hand at the end of the year totalled 39,310 tons, as compared with 20,921 tons on hand on December 31, 1909.

The following tabulated statement shows the production and shipments during 1910 and the stock on hand at the end of the year:—

	Production.	Shipments.			Stock on hand Dec. 31.	
	Tons.	Tons.	Value.	Per ton.	Tons.	Value.
			$	$		$
Crude No. 1	1,971	1,688	445,130	263 70	1,605	426,782
" " 2	2,844	1,732	171,684	99 12	2,842	405,419
Mill stock No. 1	16,026	12,830	701,681	54 69	6,933	403,747
" " 2	56,321	42,612	997,987	23 42	24,541	591,752
" " 3	19,006	16,816	142,447	8 47	3,389	29,988
Total asbestos	96,168	75,678	2,458,929	32·49	39,310	1,857,688
Asbestic		24,707	17,629	0·71		

In the absence of a uniform classification of asbestos of different grades, the above sub-divisions have been adopted purely on a valuation basis. Crude No. 1 comprising material valued at $200 and upwards and Crude No. 2 under $200. Mill stock No. 1 includes stock valued at from $45 to $100; No. 2 from $20 to $30; No. 3 under $15.

The shipments of asbestos in 1909 were in detail as follows:—

Crude No. 1: 912 tons, value $246,655, or $270.37 per ton;
Crude No. 2: 2,162 tons, value $328,855, or $152.11 per ton.
Mill stock No. 1: 14,776 tons, value $785,731, or $53.18 per ton;
Mill stock No. 2: 32,417 tons, value $800,728, or $24.70 per ton;
Mill stock No. 3: 13,082 tons, value $122,618, or $9.37 per ton;
Total: 63,349 tons, value $2,284,587, or $36·06 per ton; asbestic, 23,951 tons, value $17,188.

The exports of asbestos during the twelve months ending December, 1910, are reported by the Customs Department as 71,485 tons, valued at $2,108,632, comprising: 57,939 tons, valued at $1,505,477 to the United States; 6,700 tons, value $280,452, to Great Britain; 440 tons, value $15,925, to Germany; 2,187 tons, value $94,619, to France, and 1,242 tons, value $43,948 to other countries.

The imports of manufactures of asbestos during the same period are reported as valued at $230,489.

Corundum.

There was an increased production of corundum in 1910. The quantity of corundum ore treated during the year was 37,183 tons, from which was produced 1,686 tons of grain corundum. The shipments were 106 tons sold in Canada and 1,774 tons sold in other countries, a total of 1,870 tons, valued at $198,680.

Coal and Coke.

The total coal production in Canada in 1910, comprising sales and shipments, colliery consumption and coal used in making coke, is estimated at 12,796,512 short tons, valued at $29,811,750. This is an increase of 2,295,037 tons, or nearly 22 per cent over the production of 1909, and is the largest production of coal yet recorded for Canada.

There has been an increased production from practically all the larger collieries, and in the Province of Alberta many new mines are being opened up and developed. The largest increases have been in the west—Alberta showing an increase of nearly 42 per cent and British Columbia over 27 per cent, while Nova Scotia shows an increase of a little over 13 per cent. The total production is almost equally divided this year between the eastern and western coal fields; Alberta contributing about 22 per cent of the whole as compared with 10 per cent in 1905 and 5 per cent in 1900.

The production by provinces was approximately as follows, the figures for 1908 and 1909 being also given. With respect to Alberta, while the table below shows a production in 1910 of 2,824,929 tons, the Provincial Mine Inspector estimates the output at over 3,000,000 tons.

Province.	1908.		1909.		1910.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
		$		$		$
Nova Scotia	6,652,539	13,364,476	5,652,089	11,354,643	6,407,091	12,871,388
British Columbia	2,333,708	7,292,838	2,606,127	8,144,147	3,319,368	10,373,024
Alberta	1,685,661	4,127,311	1,994,741	4,838,109	2,824,929	6,161,055
Saskatchewan	150,556	253,790	192,125	296,339	190,484	293,448
New Brunswick	60,000	135,000	49,029	98,496	53,455	106,910
Yukon Territory	3,847	21,158	7,364	49,502	1,185	5,925
Totals	10,886,311	25,194,573	10,501,475	24,781,236	12,796,512	29,811,750

The exports of coal are reported by the Customs Department as 2,377,049 tons, valued at $6,077,350, as compared with exports of 1,588,099 tons in 1909, valued at $4,456,342.

Imports of coal during the year include: bituminous, 5,966,466 tons, valued at $11,919,341; slack, 1,365,281 tons, valued at $1,795,598; and anthracite 3,266,235 tons, valued at $14,735,062; or a total of 10,597,982 tons, valued at $28,450,001.

There was a greater importation of each class of coal than in 1909, when the total imports were 9,872,924 tons.

Coke.—The total production of oven coke in 1910 was about 897,273 short tons, as compared with a production of 862,011 tons in 1909. The total quantity of coal charged to ovens was 1,373,793 short tons. By provinces the production

was: Nova Scotia, 507,996 tons; Ontario, 25,959 tons; Alberta, 121,578 tons, and British Columbia, 241,740 tons. The coke is all made from Canadian coal with the exception of that made by the Atikokan Iron Company at Port Arthur, Ontario. All of the coke produced was used in Canada with the exception of 50,922 tons sold for export to the United States, chiefly from Alberta. The quantity sold for export in 1909 was 77,407 tons.

The quantity of coke imported during the calendar year was 737,088 tons, valued at $1,908,725, as compared with imports of 661,425 tons, valued at $1,508,627, in 1909.

Chromite.

No returns of production of chromite have been received, but 619 tons are reported as having been shipped by rail from Coleraine and Black Lake. An export of 15 tons valued at $150 is also reported by the Customs Department.

Petroleum and Natural Gas.

The production of crude petroleum shows another large falling off in 1910, the production being only 315,895 barrels, or 11,056,337 gallons, valued at $388,550; as compared with 420,755 barrels, or 14,726,433 gallons, valued at $559,604, in 1909. The average price per barrel was also less, being about $1.23 in 1910, as compared with $1.33 in 1909.

The above statistics of production have been kindly furnished by the Trade and Commerce Department, and represent the quantities of oil on which bounty was paid, the total bounty payments being $165,845.06 in 1910 and $220,896.50 in 1909.

The production in Ontario by districts, as furnished by the Supervisor of petroleum bounties, was, in 1910, as follows, in barrels: Lambton, 205,456; Tilbury and Romney, 63,058; Bothwell, 36,998; Leamington, 141; Dutton, 7,752, and Onondaga (Brant county), 1,005.

The production in New Brunswick was 1,485 barrels.

In 1909 the production by districts was as follows, in barrels: Lambton, 243,123; Tilbury and Romney, 124,003; Bothwell, 38,092; Leamington, 5,929, and Dutton, 9,513. New Brunswick produced 95 barrels.

While the production has been decreasing the imports as might be expected, have been increasing. The total imports of petroleum oils, crude and refined, in 1910, were 84,629,334 gallons, valued at $4,826,745, in addition to 1,362,235 pounds of wax and candles, valued at $80,106. The oil imports included: crude oil, 53,604,053 gallons; refined and illuminating oils, 7,656,727 gallons; gasoline, 16,679,691 gallons; lubricating oils, 4,081,257 gallons; other petroleum products, 2,607,606 gallons.

The production of natural gas was valued at $1,312,614, being $68,568 for the Province of Alberta and $1,244,046 for Ontario. These values represent as closely as can be ascertained the value received by the owners of the wells for gas produced and sold or used and do not necessarily represent what the consumers

have to pay for the gas, since in a number of instances the gas is re-sold once or twice by pipe line companies before reaching the consumer. In Alberta, also, some gas is being used by brick manufacturers for which no estimate has been obtained as to quantity or value. The total quantity of gas used in Ontario exceeded 7,036 million feet, and in Alberta over 450 million feet. A considerable flow of gas is reported from the new wells of the Maritime Oil Company, Limited, in Albert county, New Brunswick, which it is proposed to pipe to Moncton.

Salt.

Complete returns of salt production show total sales of 84,092 tons, valued at $409,624, for the salt alone. Packages used were valued at $173,446. Stock on hand at the end of the year was reported as 2,474 tons. Two hundred and eight men were employed and $112,909 paid in wages. The production was about the same as in 1909.

Imports of salt during the calendar year were: salt in bulk and bags dutiable, 20,174 tons, valued at $97,326, and salt free of duty 108,794 tons, valued at $364,735.

Cement.

Complete statistics have been received from the manufacturers of cement, covering their production and shipments during the year 1910. These returns show that the total quantity of cement made during the year, including both Portland and slag cement, was 4,396,282 barrels, as compared with 4,146,708 barrels in 1909, an increase of 249,574 barrels, or 6 per cent.

The total quantity of Canadian Portland cement sold during the year was 4,753,975 barrels, as compared with 4,067,709 barrels in 1909, an increase of 686,266 barrels, or 16·87 per cent. The total consumption of Portland cement in 1910, including Canadian and imported cement, and neglecting an export of Canadian cement valued at $12,914, was 5,103,285 barrels, as compared with 4,209,903 barrels in 1909, or an increase of 893,382 barrels; or 21·22 per cent.

Detailed statistics of production during the past four years are shown as follows:—

	1907.	1908.	1909.	1910.
	Barrels.	Barrels.	Barrels.	Barrels.
Portland cement sold	2,436,093	2,665,289	4,067,709	4,753,975
" " manufactured	2,491,513	3,495,961	4,146,708	4,396,282
Stock on hand January 1	299,015	383,349	1,098,239	1,180,231
" " December 31	354,435	1,214,021	1,177,238	822,538
Value of cement sold	$3,777,328	$3,709,063	$5,345,802	$6,414,315
Wages paid	$956,080	$1,275,638	$1,266,128	$1,323,264
Men employed	1,786	3,029	2,498	2,085

The average price per barrel at the works in 1910 was $1.34, as compared with an average price of $1.31 reported for 1909, and $1.39 in 1908.

The imports of Portland cement into Canada during the twelve months ending December 31, 1910, were 1,222,586 hundredweight, valued at $468,046. This is equivalent to 349,310 barrels of 350 pounds at an average price per barrel of $1.34. The imports in 1909 were 142,194 barrels, valued at $166,669, or an average price per barrel of $1.17.

The imports from Great Britain during 1910 were 123,880 barrels valued at $130,951; from the United States 168,972 barrels valued at $253,463; from Belgium 19,027 barrels, valued at $20,618; and from other countries 37,431 barrels, valued at $63,014.

Following is an estimate of the Canadian consumption of Portland cement for the past six years:—

Calendar Years.	Canadian.		Imported.		Total.
	Barrels.	Per cent.	Barrels.	Per cent.	Barrels.
1905	1,346,548	59	918,701	41	2,285,249
1906	2,119,764	76	665,845	24	2,785,609
1907	2,436,093	78	672,630	22	3,108,723
1908	2,665,289	85	469,049	15	3,134,338
1909	4,067,709	97	142,194	3	4,209,903
1910	4,753,975	93	349,310	7	5,103,285

EXPORTS OF THE PRODUCTS OF THE MINE, YEAR 1910.

(Compiled from Trade and Navigation Monthly Statements).

Products.		Quantity.	Value.
			$
Arsenic	Lbs.	4,512,673	173,932
Asbestos	Tons.	71,485	2,108,632
Barytes	Cwt.	5	150
Chromite	Tons.	15	150
Coal	"	2,377,049	6,077,350
Feldspar	"	15,601	47,962
Gold			5,491,051
Gypsum	Tons.	346,081	416,725
Copper, fine, in ore, etc	Lbs.	56,964,127	5,840,553
Lead, in ore, etc	"	46,800	1,308
" pig	"	7,712,253	248,174
Nickel, in ore, etc	"	36,014,782	4,039,040
Platinum, in ore, concentrates, etc	Ozs.	2,254	62,776
Silver, in ore, etc	"	30,699,770	15,649,537
Mica	Lbs.	937,263	330,903
Mineral pigments	"	3,491,737	29,839
Mineral water	Gals.	16,136	7,169
Oil, refined	"	2,818	462
Ores—			
Antimony	Tons.	239	14,095
Iron	"	114,499	324,186
Manganese	"	4	160
Other ores	"	9,534	641,426
Plumbago	Cwt.	15,768	53,008
Pyrites	Tons.	30,434	110,071
Salt	Lbs.	275,200	2,618
Sand and gravel	Tons.	624,824	407,974
Stone, ornamental	"	446	3,352
" building	"	63,407	18,867
" for manufacture of grindstones	"	308	338
Other products of the mine			134,462
Manufactures—			
Brick	M.	390	2,762
Aluminium, in bars, etc	Cwt.	77,224	1,160,242
" manufactures of			3,741
Cement			12,914
Clay, manufactures of			9,061
Coke	Tons.	57,971	250,715
Grindstones, manufactured			23,164
Gypsum, ground			12,306
Iron and steel—			
Stoves	No.	1,058	15,832
Castings, N.E.S			51,958
Pig iron	Tons.	9,763	296,310
Machinery (linotype machines)			39,438
" N.E.S			301,961
Sewing machines	No.	17,834	188,196
Typewriters	"	5,970	409,326
Scrap iron and steel	Cwt.	233,264	171,603
Hardware, tools, etc			88,844
" N.E.S			43,472
Steel, manufactures of			1,110,925
Lime			44,762
Metals, N.O.P			133,426
Plumbago, manufactures of			66,658
Stone, ornamental			5,272
" building			80
Total			46,679,238

SESSIONAL PAPER No. 26a

THE MINERAL PRODUCTION OF CANADA IN 1909.

(Revised.)

Product.		Quantity.	Value. (*b*)	Per cent of Total.
METALLIC.			$	%
Antimony ore	Tons*	35	1,575	.....
Antimony, refined	Lbs.	61,207	4,285	.....
Cobalt (k)	"	.....	94,609	0·10
Copper (c)	"	52,493,863	6,814,754	7·42
Gold	Ozs.	453,865	9,382,230	10·22
Pig iron from Canadian ore (d)	Tons.	149,444	2,222,215	2·42
Iron ore (a)	"	21,956	61,954	.....
Lead (e)	Lbs.	45,857,424	1,692,139	1·84
Nickel (f)	"	26,282,991	9,461,877	10·30
Silver (g)	Ozs.	27,529,473	14,178,504	15·44
Zinc ore	Tons.	18,371	242,699	0·26
Total		.....	44,156,841	48·08
NON-METALLIC.				
Arsenic	Tons.	.....	67,446	.....
Asbestos	"	63,349	2,284,587	2·49
Asbestic	"	23,951	17,188	.....
Chromite	"	2,470	26,604	.....
Coal	"	10,501,475	24,781,236	26·99
Corundum	"	1,491	162,492	0·18
Feldspar	"	12,783	40,383	.....
Graphite	"	864	47,800	.....
" artificial	"	257	.....	.....
Grindstones	"	4,275	54,664	.....
Gypsum	"	473,129	809,632	0·88
Magnesite	"	330	2,508	.....
Mica	"	369	147,782	0·16
Mineral pigments—Barytes	"	179	1,120	.....
" " Ochres	"	3,940	28,093	.....
Mineral water	.....	.....	175,173	0·19
Natural gas (h)	.....	.....	1,207,029	1·31
Peat	Tons.	60	240	.....
Petroleum (i)	Bls.	420,755	559,604	0·61
Phosphate	Tons.	998	8,054	.....
Pyrites	"	64,644	222,812	0·24
Quartz	"	56,924	71,285	.....
Salt	"	84,037	415,219	0·45
Talc	"	4,350	10,300	.....
Total	.....	.....	31,141,251	33·91

* Short tons throughout.

(a) Exports.

(b) The metals, copper, lead, nickel, and silver are for statistical and comparative purposes valued at the final average value of the refined metal. Pig iron is valued at the furnace, and non-metallic products at the mine or point of shipment.

(c) Copper content of smelter products and estimated recoveries from ores exported, at 12·982 cents per pound.

(d) The total production of pig iron in Canada in 1909 was 757,162 tons, valued at $9,581,864, of which it is estimated 607,718 tons valued at $7,359,649 should be credited to imported ores.

(e) Refined lead and lead contained in base bullion exported at 3·690 cents per pound, the average price for the year in Toronto.

(f) Nickel content of matte produced at 36 cents per pound (the average minimum quotation for nickel in New York less 10 per cent). The value of the nickel contained in matte was, as returned by the operators, $2,810,748, or an average per pound of 10·7 cents.

(g) Estimated recoverable silver at 51·503 cents per ounce.

(h) Gross returns for sale of gas.

(i) Quantity on which bounty was paid and valued at $1.33 per barrel.

(k) Value received by shippers of silver cobalt ores for cobalt content.

THE MINERAL PRODUCTION OF CANADA IN 1909—*Concluded.*

(*Revised.*)

Product.		Quantity.	Value.	Per cent of total.
STRUCTURAL MATERIALS AND CLAY PRODUCTS.			$	%
Cement, Portland	Bls.	4,067,709	5,345,802	5·82
Clay products—				
Bricks, common	No.	539,228,708	4,212,424	4·59
" pressed	"	57,264,656	630,677	0·69
" paving	"	3,759,803	67,408	....
" moulded and ornamental			8,866	.....
Fireclay and fireclay products			78,132	.....
Fireproofing and architectural terra-cotta			113,886	0·12
Pottery			285,285	0·31
Sewer-pipe			645,722	0·70
Tiles, drain	No.	27,571,097	408,440	0·44
Lime	Bus.	5,592,924	1,132,756	1·23
Sand-lime brick	No.	27,052,864	201,650	0·22
Sand and gravel (exports)	Tons.	481,584	256,166	0·28
Slate	Squares.	4,000	19,000	.....
Stone—				
Granite			454,824	0·50
Limestone			2,139,691	2·33
Marble			158,441	0·17
Sandstone			374,179	0·41
Total, structural material, etc.			16,533,349	18·01
" all other non-metallic			31,141,251	33·91
Total, non-metallic			47,674,600	51·92
" metallic			44,156,841	48·08
Total value, 1909			91,831,441	100·00

ANNUAL MINERAL PRODUCTION IN CANADA, SINCE 1886.

Year.	Value of production.	Value per capita.	Year.	Value of production.	Value per capita.
	$	$ cts.		$	$ cts.
1886	10,221,255	2 23	1899	49,234,005	9 27
1887	10,321,331	2 23	1900	64,420,877	12 04
1888	12,518,894	2 67	1901	65,797,911	12 25
1889	14,013,113	2 96	1902	63,231,836	11 55
1890	16,763,353	3 50	1903	61,740,513	11 03
1891	18,976,616	3 92	1904	60,082,771	10 36
1892	16,623,415	3 39	1905	60,078,999	11 35
1893	20,035,082	4 04	1906	79,286,697	12 55
1894	19,931,158	3 98	1907	86,865,202	13 35
1895	20,505,917	4 05	1908	85,557,101	12 32
1896	22,474,256	4 38	1909	91,831,441	12 82
1897	28,485,023	5 49	1910	105,040,958	14 02
1898	38,412,431	7 32			

APPENDIX II.

CONFERENCE ON PROPOSED LEGISLATION TO REGULATE THE MANUFACTURE, IMPORTATION, AND THE TESTING OF EXPLOSIVES.

OTTAWA,
September 26, 1910.

SIR:—I beg to transmit, herewith, a copy of the proceedings in connexion with the Conference on the proposed legislation to regulate the manufacture, importation, and testing of explosives, held in Room 16, House of Commons, Ottawa, on September 23, 1910. At the said Conference it was resolved that the proceedings be immediately printed, and placed in the hands of those in attendance, so that the recommendations of Captain Desborough—H.M. Inspector of Explosives—could be deliberately considered, and dealt with at the adjourned meeting to be held in Room 16, House of Commons, Ottawa, on Friday next, September 30, at 10 a.m.

Hoping you may find it convenient to be present.

Yours very truly,

(Signed) **Eugene Haanel,**
Director of Mines.

Digest of Proceedings.

ROOM 16, HOUSE OF COMMONS,
OTTAWA, September 23, 1910.

The Conference met at 10 a.m., Dr. Eugene Haanel, Director of Mines, in the chair. The attendance was as follows:—

Captain Desborough, H.M. Inspector of Explosives, Home Office, London.
Thomas C. Gibson, Deputy Minister of Mines for Ontario, Toronto.
Joseph G. S. Hudson, Mines Branch, Dept. of Mines.
Winthrop Brainard, Vice-President Hamilton Powder Company, Montreal.
J. Murray Wilson, Manager Hamilton Powder Company, Beloeil Station, Que.
G. A. Wutty, Manager Hamilton Powder Company, Windsor Mills.
D. W. Brainard, Dominion Cartridge Company, Montreal.
E. J. Johnston, Dominion Cartridge Company, Brownsburg, Que.
W. D. Barclay, Gen. Man. C.N. and Q. and L. St. John railways, Que.
E. Tiffin, Intercolonial railway, Moncton, N.B.
A. J. Hills, Supt. C.N.O. Ry., Toronto.
M. J. Butler, Gen. Man. Dominion Iron, Steel, and Coal Company, Sydney, C.B.
W. H. McDougall, Asst. Gen. Man., Dominion Iron, Steel, and Coal Company, Sydney, C.B.

A. C. Tagge, Gen. Supt. Canada Cement Company, Montreal.
C. D. McPhee, G. and M. Fuse Works, Arnprior, Ont.
A. E. Blood, Bureau Safe Transportation of Explosives, New York, Toronto
Col. J. M. Taylor, Bureau of Safe Transportation of Explosives, New York.
Daniel Smith, President Ontario Powder Company, Kingston.
C. A. McPherson, Secretary Ontario Powder Company, Kingston.
W. T. Roddin, President Standard Explosives Company, Montreal; Western Export Company, Vancouver.
W. M. Lowery, President Ontario Torpedo Company, Petrolia.
H. R. Drackett, Superintendent Standard Explosives Company, Vaudreuil.
Jas. J. Riley, Vice-President Northern Explosives Company, Montreal.
E. A. LeSueur, Ottawa.
G. M. Howard, A. L. Howard Company, Fulminate of Mercury Works, Sherbrooke, Que.
H. A. Nicholls, Dominion Explosives Company, Ottawa.
Lionel Kent, The Energite Explosives Company, Montreal.
P. E. LeMarch, The Energite Explosives Company, Cobalt.

The CHAIRMAN.—As you are aware, the Honourable Mr. Templeman, Minister of Mines, proposes to introduce at the next session of Parliament a Bill to regulate the manufacture, importation, and testing of explosives in the Dominion of Canada. The Department of Mines last year drafted a Bill for presentation to the House. We deemed it advisable, however, before presenting a Bill on so important a matter, to avail ourselves of the experience of His Majesty's Inspector of Explosives in England who has for many years administered the English law, and who is at the head of the testing station in England. I, therefore, recommended the Minister that application be made to the Home Office in order that we might avail ourselves of his services; and they have been good enough to loan him to us. He has travelled over the country and inspected the various factories where explosives are manufactured, and made himself conversant with the conditions in Canada. He is now prepared to offer certain recommendations, and I have called this conference in order that you might hear the recommendations which Captain Desborough is to make to the Government; so that you might have an opportunity of taking note of his recommendations, and offering your own suggestions, and possibly criticisms in connexion with these recommendations. I shall now call upon Captain Desborough to be good enough to state to you what his recommendations will be.

Captain DESBOROUGH.—Doctor Haanel and gentlemen, the task you have put upon me is rather difficult to carry out in such a short time. I have only been able to get a very general idea of your conditions here, and I felt it was absolutely necessary before I sent in an official report, that the recommendations which I shall sketch out roughly to you—the gist of my recommendations—should be submitted to you for your criticism. The first principle which should be adopted in framing regulations to govern the explosives industry is, what we call in England, the system of authorization of explosives. The meaning of that is this, that before any explosive is allowed to be imported or manufactured for sale, the explosive has to be submitted to the chemical advisers of the explosives department, and they

have to satisfy themselves that it is reasonably insensitive to friction and percussion, and that it possesses a reasonable degree of chemical stability. This does not preclude the manufacture of experimental explosives to enable a manufacturer to work out a new type of explosive, but it means that before that explosive is put on the market it must go through the hands of the chemical advisers of the Department. I do not know that it is necessary for me to go into the details of the principles on which our chemical advisers examine explosives. In fact I am sure it would take much too long, but amongst the tests they use are those of the falling weight and the broom stick test, which does not seem to be known over here. The method of the broom stick test is to spread out a thin layer of the explosive on a wooden board and strike it a glancing blow with a wooden broomstick. Ordinary gunpowder can readily be fired in that way. Then, as far as chemical tests of explosives go, the principal test used is known as the heat test. I imagine that most manufacturers here are more or less familiar with the details of the heat test, so I need not refer to it here. In conjunction with the heat test, they keep the explosives in alternately dry and moist atmospheres, at a temperature of about 90 degrees Fahrenheit, and take the heat test from time to time, and observe the effect on the heat test. There is also another test, to ascertain if an explosive containing nitro-glycerine is liable to exudation or liquefaction. The next point is the manufacture of the explosive. I think the Dominion Government should alone be responsible for the licensing of factories. As they will be responsible for the type of explosive which is put on the market, they ought to have some control over the manufacture. The principle we use in England regarding the licensing of factories depends on what we call the table of distances. That is, the maximum quantity of explosive allowed to be in any building depends on the distance it can maintain from other buildings connected with the factory, and also from certain prescribed buildings and works outside the factory. These distances are shown in two tables of which I have copies here. One is called the table for outside distances, and the other is what we call the intra-factory distance table. I will just give you one instance here. Take a blasting explosive. We should be prepared to allow 30,000 pounds in a building, provided it was adequately mounded, and was at a distance of 65 yards from other buildings. If the mound were not erected, then we should cut down the quantity to 6,000 pounds. It shows the great trust we put in mounded buildings. Other points which the licenses should embody are the construction of the buildings. We do not lay down any hard and fast construction for any particular buildings; but we work on the principle that buildings in which operations of manufacture are carried out should generally be of light construction, so that in the event of an explosion there should be no heavy debris flying about the factory. As far as storage is concerned, we insist at present on substantial buildings. The reason of this is, that we consider danger of explosion in a magazine comes mostly from without. If a system of authorizing explosives is enforced there should be no danger of spontaneous ignition inside a magazine. Therefore, it is necessary to have the magazine fairly substantial to protect it from dangers from without. That does not mean of necessity that you are to have your buildings constructed of either stone or brick. In certain cases we have corrugated iron magazines, which in our climate have very great advantages. If you have an explosion in a corrugated iron magazine the corrugated iron crumples up and does not fly. I

would not propose in any legislation to lay down hard and fast rules as to the construction of buildings, but would have each case considered on its merits. If a manufacturer could provide a light construction and at the same time protect it from outside dangers, I think he should be perfectly at liberty to use such a structure.

Then as regards the number of work-people allowed in a building, we in our licenses limit the number. We have no very strict rule about it, but we think, and I am sure the manufacturers will agree with me, that it is advisable to limit the number as far as possible. As a general rule in buildings where nitro-glycerine is manufactured, the maximum number of persons employed is four. In buildings where the explosive is packed into cartridges, the maximum is four. Where the cartridges are boxed the limit of six is generally assigned. One of the points which struck me over here is that, as a general rule, you crowd your explosives up too much. It means that if you get an explosion in one building you not only lose probably a good deal of life, but you put your factory out of action. Now, on economic grounds, I believe it would be sounder for you to split up your risks—have smaller quantities and more buildings. With large quantities it is necessary to have your buildings very much apart. What has impressed itself on me very much is the fact, that in one factory—I will not mention names—they killed eleven people last year in packing cartridges. In the whole of England the average death rate is about five or six a year, and the actual use in England is about 15,000 tons, and the output somewhere in the neighbourhood of 40,000 tons, so I think you can do a great deal in preventing the loss of life which has gone on here. There is one other point about the licensing of factories; the system we follow is that the applicant should practically, in consultation with our Department, draft the license. When the terms and details have been arranged, the applicant has to lay the draft of the license before the local authorities. In this country presumably it would be the municipality, but of that, of course, I am not competent to speak. Then the local authority can either give its assent to the establishment; or its assent with conditions; or its dissent. In those circumstances an inspector of explosives is sent down to hold an inquiry, and to make a report to the Home Office. On his report the Home Secretary can either agree with the local authorities. decision, or over-ride it, or assent with modified conditions. He has an absolutely free hand. There are several occasions on which the local authorities have dissented, and their dissent has been upheld. In one case the factory had made no arrangements about the discharge of acid affluents, and they were proposing to discharge it into the river where the local authorities thought it would be objectionable. In that case the dissent was upheld. On one occasion the local authorities said they thought the distance of the various buildings from neighbouring dwelling houses was not sufficient. As these distances were based on our table of distances the Home Secretary refused to allow their dissent, and the license was granted. There is one other point on which I have not touched, and that is, the position of existing factories. I think existing factories should not be treated in the same way as new factories, for the present, and I propose to recommend that a certain time should elapse before they come into conformity with the system which I have outlined, except in the case of any definite building which may be regarded as a menace to the public. I do not mean that the public must come and say they

think a building is definitely dangerous, but that the officers appointed under the new Act, when visiting a factory, should take particular note if there is any building which they think is absolutely dangerous, or is thought to occasion any special danger, and that then the manufacturer should be required to make some alteration, possibly by the erection of a mound screening the building, and possibly by the reduction of the maximum quantity allowed in the building.

The next point is the storage of explosives. I do not think the new Bill should interefere with any magazines which are lawfully existing at the present time in virtue of licenses granted by the provincial authorities. It is perfectly unnecessary, to my mind, to duplicate the work; the new department will have plenty of work without interfering with existing licensed magazines. With regard to magazines which are not licensed, I think a somewhat similar procedure should be adopted to that I have sketched for licensing factories—that is, the site should depend upon the distance the magazine could maintain from outside works, and the quantity should also be limited in accordance with this distance.

There is another point, the question of lightning conductors. I am not suggesting that the English practice should be followed, that every magazine should be equipped with a lightning conductor. The effect in England is that a bit of copper wire is attached to a building and occasionally it is about as much use as a horse-shoe would be on a door. What I have suggested is, that members of the scientific staffs of universities in Canada, together with representatives of the explosives trade, should form a committee, and that committee should consider the best and most economic form of protection from lightning which they can devise, and then in the interest of safety I think the occupiers of the magazines would be well advised to protect their buildings in such a way.

Then the next point is the transportation of explosives. As far as transportation by rail is concerned, I think matters should be left exactly as they are—that is, that the Railway Commissioners should control the transportation. The only difference the new legislation will have as regards that is that the quality of the explosive will be better looked after, not only when it is first made, but subsequently by a system of sampling which I shall talk about later. As regards transportation by water and by road, I think general regulations should be made, not in detail in the Act, but in virtue of sections in the Act. Generally speaking, what is desired in any Act is not to put in detail, but simply give the Minister of Mines power to make regulations. If detail is put in, the practice becomes hard and fast, and there is no scope for making changes to meet special conditions. There is one point I met in transportation by water in the far west; I heard of a case where 100 tons of explosives were put on a vessel and on top of this 100 tons a cargo of gasoline was placed. I think that is absolutely wrong. If a fire started in that vessel, and it was in the middle of Vancouver harbour, the shipping would be considerably diminished.

There is a point that has nothing to do with legislation, that has struck me—that is, the use of floating magazines where the climatic conditions are suitable. In England a large part of our explosives is stored in floating magazines. These consist of old hulks which are moored in places directed by the harbour authority, and the explosive is stored below the water line. It is a very convenient form of storage. It is out of the way of the public. You will not have people trespassing

around your magazine, and it is very convenient where transportation by water is to be effected afterwards. I think such buildings should be licensed in much the same way as an ordinary magazine.

Another question is the importation of explosives. I think the English lines should be followed pretty closely there—that is, that no explosive should be imported into the country for sale until it has been authorized. It will be authorized in exactly the same way as other explosives, and when an explosive has been authorized before the importer takes out a license to import, he should have at his disposal a licensed place of storage; a license not being granted until he can show that he has storage accommodation for the explosives he proposes to import. On importation the explosive will be consigned directly to a specified place, where the samples will be taken by the Customs Officers; and until those samples have been examined by the chemical department, and reported upon as satisfactory, the explosive should remain under detention at the place of storage. If the samples prove satisfactory on examination, the explosives would be released. If they were doubtful an opportunity might be granted of further sampling, and possibly the explosive released on the condition it was used up within a limited time. If the explosive proved to be of bad quality, but not immediately dangerous, it ought to be exported, and if of a bad quality and dangerous, it should be destroyed. This would apply to explosives coming from the United States, or any other part of the world.

Then the next point is the system of inspection and sampling. It is perfectly useless to have any licensed places unless you have a certain number of people who will pay visits to see that the terms of the license are observed. I do not think you will find inspection—provided that suitable selection is made of the class of persons appointed inspectors—a very formidable thing to encounter. I think I may say that in England we are not regarded as arch enemies by most manufacturers, and very often we are regarded more as a bureau of information and assistance. It is absolutely necessary that the inspector should take samples, not only of current manufacture, but of explosives that have been manufactured for some time, to see that the standard is being maintained.

The next point, which is somewhat of detail, is the establishment of a testing station, which will be primarily for coal mine explosives. I do not know that it is necessary for me to go into the details of the test; but generally speaking the test consists of firing a charge from a cannon into an inflammable atmosphere of air and coal gas, or any other gas which may be settled on; also firing charges of explosives into a gallery in which coal dust has been placed. I have with me here a copy of the last Belgium permitted list, showing the types of explosives which have passed the Belgian test. I cannot guarantee that similar explosives will pass the new test here, but it will give you an indication roughly of the class of explosives it will probably be necessary to manufacture. There is a practical point in the working of the testing station which our manufacturers now admit—that before the testing station was established they used to incorporate their explosives for a certain time, and were absolutely convinced that they were the very best on the market and thoroughly incorporated. Since the establishment of the test station they have become satisfied that incorporation is not at all an easy thing, and it is not merely sufficient to mix things together in a rough and ready way, but a good

deal of attention has to be paid to the method of mixing. The test we use for comparing the relative kinetic value consists of a ballistic pendulum. With well made explosives firing charges of four ounce weight, I get a swing of rather over 3″, and if I fire three shots I do not expect to get a greater variation than 0·010 of an inch. Then another point which might be taken up with the testing station is, investigations not only into the kinetic energy by ballistic pendulum, but also the velocity of the explosion. The object of this is to give the user some sort of idea of what a particular explosive will do. At present each new inventor says his explosive will do everything. People who deal with explosives know that is absolute nonsense. Explosives suitable for one sort of work will not do for another sort. What must be ascertained is the kinetic energy and the velocity of explosion.

Then there is the investigation of accidents in factories. If any accident by fire or explosion occurs in a factory, whether it causes bodily injury or not, it should be reported and investigated, if not by the inspector, at any rate by the staff of the factory. Very often far more is learned from an accident which does not cause injury than from one where everything is wiped out. I should like to make a criticism here generally of the factories I have visited. I think that on general lines you are right enough, but you do not pay sufficient attention to details. You have to remember that the main causes of explosions are apart from fire and spontaneous decomposition, which should not occur in a factory—except, perhaps in case of nitro-glycerine. Where decomposition takes place, there, as a rule, it does not cause an explosion. You can drown the charge in time. The danger is, of striking a thin film of explosive a blow. That will be very much worse if there is grit mixed with the explosive, and what you want particularly to look to is, to avoid any unnecessary blows. In one factory—I cannot remember the name of the machine, but it is an ordinary cartridge packing machine—I found the two big supports of the machine were loose, and every time this machine was operated it came down with a thump on the ground. Now that should not have been allowed. It was running an unnecessary risk and there was no object to be gained. Another point is that steps ought to be taken to prevent grit getting into an explosive. You cannot avoid it altogether, but you can take such steps as are possible, and one is lining the building. I notice here rubberoid is used. It seems to be an excellent material for lining a building. The buildings were as a rule properly lined, but some were not.

Then as regards accidents, in storage, transportation, and use of explosives. I feel quite sure that the Provincial Governments will assist the new department by giving information regarding accidents, both in storage and use; but it is useless to make what I might call a book of casualties. You want to have the accidents investigated in a more or less intelligent way, because it is only by ascertaining the causes of accidents and the nature of accidents, that it is possible to suggest any means of preventing them. Of course I do not mean for a moment to suppose that one will ever be able to entirely prevent accidents. That, of course, is impossible. Perhaps it would be convenient if I shortly told you the cause of accidents in the use of explosives in England. Many of them come, of course, from the use of frozen explosives. That is a thing that supervision alone can guard against. Then a certain number of accidents come from the use of weak or inefficient detonators. I am not prepared to offer any suggestion as to how you can get around that

except by going for the manufacturer of the detonators, and insisting that the quality shall be good. I know of no really satisfactory test for comparing the strength of detonators; but it is a subject which should receive attention when the new testing station is established here. We have been meaning to take it up in England for a number of years, but the opportunity has never offered. Then there is another kind of accident which is very common in England. It is striking unexploded cartridges in removing debris. This is either due to frozen explosives, or to a weak detonator, or to a fault in the explosive itself. That refers more to gelatinous explosives.

Mr. BRAINARD, *Hamilton Powder Company.*—There are some things in connexion with Mr. Desborough's remarks which I should like to get information about. In this country there are a number of instances where in putting up supplies for the market you can only use the cold weather, and you have to fill up stock in the winter weather for the whole year. If you license those magazines on the maximum quantity they contain, I do not know where you would put the factories, because they would be too far away from the source of consumption, as a rule.

Captain DESBOROUGH.—What quantity would you want to put in?

Mr. BRAINARD.—It varies with the extent of the demand. Some of our magazines have 100 tons.

Captain DESBOROUGH.—According to this table, 50 tons could be 3,500 yards from a dwelling house. If you erect mounds it will be 1,750 yards. If it is so placed that the ground interposes a satisfactory screening you would be allowed to have it within 800 yards.

Mr. BRAINARD.—A number of these magazines are erected on land leased from private individuals and are not the property of the people making the explosives.

Captain DESBOROUGH.—I understand the magazines are under the control of the Provincial authorities—is that so?

Mr. BRAINARD.—I do not think private magazines on private property where explosives for their own consumption are stored, are.

Captain DESBOROUGH.—I do not know whether the Government here will accept the system we have—that is, if the occupier of a dwelling house gives his consent to the establishment of a magazine, the distances which have to be maintained are very much less. In that case the distance for 50 tons is 850 yards. That means it would be half—425 yards; if there is a mound, and if there is a substantial natural feature of the ground in between, the distance would be a quarter, or only a little over 200 yards.

Mr. BRAINARD.—Your schedule of distance would be enforced in cases of that kind?

Captain DESBOROUGH.—Yes. Personally I think you would do better to put up, instead of one magazine containing 100 tons, two magazines containing 50 tons each.

Mr. BRAINARD.—Most of these magazines are in a part of the country where concrete and sand cannot be had, and they are made of logs.

Captain DESBOROUGH.—Personally I would not object to that. No hard and fast construction should be laid down. Each case should be treated on its merits. You must not take anything I say as binding the Department at all.

Mr. BRAINARD.—When the English Explosives Act was enforced, were not existing factories licensed as they stood, without changes?

Captain DESBOROUGH.—Yes.

Mr. BRAINARD.—You do not propose to do that here?

Captain DESBOROUGH.—I am told it is not proposed to do it. It has been found very objectionable in England. In certain towns in England you walk along the main street and you hear gunpowder wheels running on either side of you. There is a magazine I am thinking of on the banks of the River Thames which has generally about 200 tons of explosives in it. That magazine is absolutely surrounded by houses and is on the river side, and if it should explode it would flood about 200 miles of country. It is an objectionable magazine and we wish we could get rid of it, but we have not the power.

Mr. BRAINARD.—I was not alluding to magazines so much as to manufacturing plants.

Captain DESBOROUGH.—In the discussions I have had with the authorities here I suggested originally that the factories should be left more or less as they are provided exceptional buildings were changed. I have been told, however, that that is not considered a good policy, so I suggested as a compromise that a limited time, so many years, should be allowed to elapse before a change was required.

Mr. BRAINARD.—I should like to know whether the proposed safety regulations for permitted explosives are to be the English?

Captain DESBOROUGH.—I ought to have told you that. The English test is being changed, and I drew up the specifications for a new gallery before leaving England. I heard this morning that they are getting on with the structure, and I suggested that the Canadian Government should wait until the English experiments are concluded. In England the gallery will be 5 feet in diameter, 44 feet long, and charges tamped with a plug will be used; and the maximum charge which will not fire the gas or dust mixture will be determined—that is the charge which will be allowed in practice. The Continental people are able to get explosives up to $2\frac{1}{4}$ pounds in weight—in fact they fill their gun completely.

Mr. BRAINARD.—You say the transportation is to be controlled by the Railway Commissioners?

Captain DESBOROUGH.—They control transportation by rail at present.

Mr. BRAINARD.—The rules will be similar to the rules in New York?

Captain DESBOROUGH.—They have adopted the same rules as the New York rules at present.

Mr. BRAINARD.—But the test will be made at Ottawa?

Captain DESBOROUGH.—Yes. There is one point I should mention. I have recommended that the Railway Commissioners should be approached regarding the transportation of small quantities of explosives. Everyone is aware that this transportation goes on now, and is nearly certain to continue, on railway trains where passengers are carried. It should be recognized that it goes on and should be regulated.

Mr. BRAINARD.—The Federal authorities have the official say about licensing; suppose there is a difference between the local authority and the Federal, will the

Federal authority prevail? Is not the object of this legislation to give the power of decision to the Federal authorities and take it out of the hands of the municipal authorities?

Captain DESBOROUGH.—It is proposed to do so as far as it is legally possible, but where the Provincial Governments have definite powers of licensing, then the Federal Government cannot come in at all. I think there is no doubt that in many cases the Provincial Governments will co-operate with the Federal Government, and I am quite sure that the Federal Government will be prepared to advise on every possible occasion.

Mr. BRAINARD.—About the strength of detonators, are you going to apply the same import rules to detonators as to explosives?

Captain DESBOROUGH.—Explosives include detonators.

Mr. BRAINARD.—There is nothing to prevent a man importing weaker detonators than are made in this country.

Captain DESBOROUGH.—Not only detonators but fireworks and sporting cartridges should all be examined. I would go further than they go in England in dealing with sporting ammunition. I think the explosives with which this ammunition is loaded should be required to come up to the same standard as that manufactured in the country.

Mr. BRAINARD.—Is it the intention of the Government to get after the consumer of these explosives as well as the manufacturer? That is, will a contractor be told that he must use only detonators of a certain strength?

Captain DESBOROUGH.—That cannot be done, I believe, as far as the use of ordinary explosives is concerned, but I think it will be done with the co-operation of the local governments as regards coal mine explosives. It would be an excellent thing if it could be done with all explosives, but I do not know if there is power.

Mr. P. LESUEUR.—In connexion with lightning protection, a principle was discovered a very long time ago which does afford absolute protection to buildings from lightning, and which has not been applied for ordinary dwellings, because of the impracticability of it, but it is quite possible for magazines. It was discovered by Faraday. It amounts to this. Inside a metal cage of any kind, as, for instance, ordinary girders of a closed bridge, no electrical phenomena can take place. This is the result, that if you have a metal roof on your magazine—tin or galvanized iron—and more or less surrounding the sides, leaving plenty of room for one door—there is only one door I believe permitted—and bury this wire netting, which may be in the form known as chicken netting, there can be no manifestation of lightning, even the mildest sort, such as would be detected by the electroscope. If a building should be actually struck by lightning, the lightning does not have a disruptive effect, provided it strikes a sufficient surface. If a wire netting were not sufficiently large it would be burned up by the electric discharge. The netting I speak of surrounding a magazine has at least twenty times sufficient carrying capacity for the heaviest lightning stroke. That appears to have been recognized in Europe; because some four years ago I saw a reference in the Engineering and Mining Journal of some place in Continental Europe where this principle, long recognized, was being applied to magazines, as being the one absolute security.

Captain DESBOROUGH.—There are very elaborate, what we call cage systems, adopted in Germany and in some places in England. My point was I did not think

anything of that sort should be prescribed until people over here, particularly manufacturers, had the opportunity of trying to work out the most economical system. I laid a great deal of stress on the economical side of it.

Mr. BRAINARD.—Black powder manufacture has not been mentioned. Are you going to impose the same restrictions as to quantities?

Captain DESBOROUGH.—The factories should be licensed on the same system. For smaller quantities there is a greater reduction of distance for gunpowder.

G. M. HOWARD, of the *A. L. Howard Company, Sherbrooke, Que.*—As regards the number of employes you mentioned only the manufacturing of dynamite and the charging of cartridges. Now, I presume the regulation regarding that would differ for different manufacturing?

Captain DESBOROUGH.—Quite so. My idea is, each case should be treated on its merits. It is impossible to lay down hard and fast rules. For instance, in sporting ammunition there is not the risk there is in loading blasting cartridges, and therefore, each case should be treated absolutely on its merits.

D. W. BRAINARD, *Dominion Cartridge Company, Montreal.*—I was wondering about working magazines. Each loading building will have a small magazine outside, with comparatively little powder in it, say four or five kegs. It means considerable expense if you have to move these a long distance, and have to be continually running backwards and forwards.

Captain DESBOROUGH.—I quite appreciate that.

Mr. BRAINARD.—We should have as large an allowance as possible for small magazines.

Captain DESBOROUGH.—We consider that we have here—for 300 pounds, twenty-five yards is the distance, but if you have a screening wall in between we allow for 200 pounds at twelve and a half yards.

Mr. BRAINARD.—Is the wall of the building counted a screening wall?

Captain DESBOROUGH.—No. I do not think you need be apprehensive of any trouble there. Probably you could by partitioning your little magazine produce the same effect.

Mr. BRAINARD.—About magazines for storing detonators, it is rather complicated on that, because as soon as you can store enough for your day's work, you will need a double handling. You will have to take them to your magazine and load them again, whereas if you could start with say 60,000——

Captain DESBOROUGH.—Sixty thousand means a very small quantity of contained explosive. The distance is based entirely on contained explosive as far as detonators are concerned.

Mr. BRAINARD.—The Canadian detonators are made of practically the same strength as the American and English, and the only trouble we have from the manufacturing point of view is, that periodically some dealer will import lightly charged caps and we cannot sell a heavily charged cap cheap enough to compete with them, and we would be forced to manufacture a lower grade.

Captain DESBOROUGH.—Would it be sufficient if the weight of the detonator were strictly defined, so that imported detonators would require to come up to the standard?

Mr. BRAINARD.—That would be satisfactory. The trouble now is that a 5 grain detonator is imported, whereas we manufacture nothing under 8·3 grains.

Captain DESBOROUGH.—The standard detonator with us is the No. 6 which contains one gramme of composition.

Mr. BRAINARD.—How would you have your testing of imported ammunition done? Every dealer will import such quantities that it would be difficult to take a sample out of it.

Captain DESBOROUGH.—It will soon become known, that each man who imports ammunition has to take out a license, and that samples will be taken by the Customs for examination by the Explosives Department, and consequently only large importations will be made.

H. R. DRACKETT, *Superintendent Standard Explosives, Vaudreuil.*—I should like to inquire how the table of distances will apply in the way of protection outside the factory. For instance, our plant is located in a heavy bush.

Captain DESBOROUGH.—We quite appreciate the value of timber for preventing the projection of debris, but there is no guarantee that timber will grow forever, and if that timber is ever destroyed you do not get the protection afforded by it, and it would upset the whole system of distances at once. That is why we do not take timber into account in measuring distances.

Mr. BRAINARD.—Is there going to be any prescribed form of buttress?

Captain DESBOROUGH.—My opinion is there should not be except in the most general terms. Practically what we find best is sand or earth without heavy rubble in it, about 3 feet thick at the top and supported on either side by timber or by corrugated iron, it stands the weather so much better in England.

Mr. LESUEUR.—About how thick would that be at the bottom?

Captain DESBOROUGH.—If you have corrugated iron or timber revetment, they are almost vertical.

Mr. LESUEUR.—A matter of about 3 feet?

Captain DESBOROUGH.—Yes, but it is objectionable having heavy rubble in these mounds. I may mention that the German Government carried out some experiments two years ago on magazine construction. They used a type of reinforced concrete and exploded fairly heavy charges inside the building. They found the particular concrete was so pulverized that there was no projection of debris for any distance.

Mr. D. H. MCDOUGAL, *Dominion Coal Company.*—You were speaking of a 100-ton storage magazine, and you suggested that it would be better to have two 50-ton magazines—how far apart would you propose to locate them?

Captain DESBOROUGH.—One hundred yards apart, or half that if there is an earth bank in between.

Mr. MCDOUGAL.—In that case the location governing the 50-ton plant, and the distances from residences would apply?

Captain DESBOROUGH.—Yes.

Mr. MCDOUGAL.—I should like to inquire if it is the intention to have explosives which are now on the permitted list in England, admitted for use in Canada without inspection on this side?

Captain DESBOROUGH.—I think it would be advisable to inspect every explosive that comes into the Dominion.

Mr. McDougal.—In that case you would propose, I presume, to be prepared for immediate inspection. Take the case of a shortage in the explosive supply, a company waiting for a consignment to arrive; would you have immediate inspection or would you propose to permit the use of explosives in the meantime?

Captain Desborough.—All I can tell you is what we do in England. We have been able from the time of importation to release occasionally within two days. Of course, your distances are somewhat greater here, but a certain amount of power ought to be allowed to the inspector, if he knew the factory and origin, to allow the explosive to be taken into use. We frequently do that in England.

Mr. McDougal.—Supposing your testing station were located at Ottawa, and the explosives arrived in Nova Scotia, it would take two days to send samples here.

Captain Desborough.—My view is this, that if any English manufacturer wished to get his explosive on the Canadian permitted list, he would submit a sample to be tested at Ottawa. Then subsequent importations would only be chemically tested, unless the occupier of the mine, or the mines inspector of the district wished any particular sample to be tested. I do not mean that each importation should go through the firing test, but only through the chemical test.

G. A. McPherson, *Ontario Powder Company, Kingston.*—May I ask if there are any drafts of the proposed Bill? It seems to me if we had a draft of the Bill actually before us we could study it and ask more pointed questions than we can in a general discussion.

Captain Desborough.—I can only give you the system in England. Any draft of a Government Bill is absolutely the property of the Minister, and kept confidential until laid on the table of the House. I imagine the same procedure is adopted here with regard to Government Bills.

Mr. McPherson.—There are many details that would be incorporated in the Act which we are scarcely in a position to consider to-day. One point occurs to me—what tests will be necessary for factories to enforce? How many tests? In making nitro-glycerine we run it in batches. Have we to test every batch or take a sample for a number of days and test it?

Captain Desborough.—The point, and a very necessary point, is that the factory should have a chemical department to see that they are bringing their explosives up to the required standard. There is no obligation on you to do so, but for your own protection you ought to do so. The original sample for authorization will be submitted by you, and will be subjected to certain tests by the chemical department: amongst others a stability test of some sort. If that sample proves itself to have a reasonable degree of chemical stability then it will be authorized, and you will be required to produce explosives which will pass a certain test. I may say that, at the present time, most explosives are examined chemically in England by what is known as the heat test. A committee is sitting at present in England to discuss the whole question of standardizing that heat test, and recommending another test which may be used as a check test. Everyone admits the heat test is not altogether satisfactory; but it happens to be a test that is very easy to carry out. What we want is that the manufacturer should not have his explosive condemned on one test, but that there should be other tests which could be used in the event of the explosive failing to pass the heat test. I might say it is very

exceptional in England, on sampling explosives, to find one which does not satisfy the heat test. I have taken samples of dynamite twenty years old and they have been perfectly satisfactory.

Mr. McPherson.—I have had the impression that the reason for the movement to have this legislation passed is the number of accidents that have occurred on works. Will there be any move to license blasters where the actual accident occurs?

Captain Desborough.—I am suggesting that where the use of explosives is not already governed by such legislation as the Mines Regulation Act, the Minister of Mines should have power to make certain rules governing the use of explosives. That I take it would apply principally to construction works. What the scope of those rules is to be I have not definitely thought out, but I thought the Department would probably form a small committee and consult users with a view to framing a code. I quite agree that some regulations to govern firing are absolutely necessary.

Mr. McPherson.—We who are engaged in the manufacturing business feel very strongly the great number of deaths is due really to the reckless handling of explosives after they reach the point of consumption rather than to any defect in the factory.

Captain Desborough.—I quite agree with you, but you have to recognize this, that if you are going to inspect every place where explosives are used you will have half the population of Canada inspecting the other half.

Mr. McPherson.—Very true, but if we are to get out of the evil we must strike at the root.

Captain Desborough.—I think rules ought to be adopted to govern the use of explosives, and inspectors should be appointed whose principal duty would be instruction, very much in the same way as the Railway Transportation Bureau send out men to give instructions.

Mr. McPherson.—In regard to the regulations I did not quite catch whether the Federal or Provincial authorities should govern. A point very vital to persons interested in the use of explosives is the possibility that the local authorities might clash with the Dominion.

Captain Desborough.—That has been the great difficulty in this legislation. I am not a lawyer, but that is a matter which is being considered by the lawyer who is looking after the legal side of the proposed legislation.

Mr. McPherson.—The point I have mostly in mind is this—the question of local taxation. A point comes to my mind now; a few years ago we attempted to open a magazine here in Ottawa. As it happened there were no regulations at the time, but the municipality exacted a license of $500 which drove us completely out of this end of the country. Suppose the Province that is interested exacts a tax, are we likely to be subject to a further tax by the municipality, a tax that appears unjust on the face of it?

Captain Desborough.—My idea is this: where the Dominion Government has power to license a magazine, that a comparatively small fee should be paid for that license, and that no other license fee should be exacted, but I cannot tell you whether the Municipal or the Provincial people have power to extract anything from you or not.

Mr. McPherson.—My reason for bringing this up was it occurred to me it might be possible to overcome that in this legislation.

Captain Desborough.—It is a point that the lawyer who is looking after the legal side of the Bill is going into.

The Chairman.—All legal questions are in the hands of the Department of Justice who are looking after this matter entirely.

W. M. Lowery, *Ontario Torpedo Company, Petrolia.*—We manufacture nitro-glycerine and use it for oil and gas wells in its natural state. How would we get samples here?

Captain Desborough.—How do you transport it?

Mr. Lowery.—With teams.

Captain Desborough.—The liquid nitro-glycerine?

Mr. Lowery.—Yes.

Captain Desborough.—Well, I cannot say that that is a wise proceeding at all.

Mr. Lowery.—That is the only way. It is just a point that occurred to me.

Captain Desborough.—A very important one from your point of view.

Mr. Lowery.—It does not come under the head of dynamite, so we cannot ship it at all.

Captain Desborough.—Do you transport it great distances?

Mr. Lowery.—Sometimes a couple of hundred miles with a team.

Captain Desborough.—Why do you not adopt the original system of Alfred Nobel, that is absorb your nitro-glycerine with kieselguhr for safe transportation, and afterwards extract the nitro-glycerine from the kieselguhr?

Mr. Lowery.—That would not do in this case. You have to use it as soon as you get it there.

Captain Desborough.—I cannot give you an answer right off. It requires a good deal of consideration.

A. C. Tagge, *Canada Cement Company.*—From the standpoint of the user of small quantities, may I ask what is your recommendation for a small magazine suitable for holding a carload, say ten tons?

Captain Desborough.—In what respect?

Mr. Tagge.—Distance from other buildings and public roads?

Captain Desborough.—That would be governed more or less by this table which would have to be modified more or less to suit Canadian conditions. Some do not apply and others should be inserted. For a dwelling house with the consent of the occupier the distance for ten tons is 250 yards, and without the consent of the occupier 850 yards. Those distances should be halved if the building is mounded, and reduced three-quarters if there are substantial natural features of the ground in between.

Mr. Tagge.—How would the location of that be with reference to public roads?

Captain Desborough.—Our distance is 120 yards without mounds.

Mr. Howard.—The transportation of samples might possibly be a very serious matter. As regards crude fulminate of mercury, it is not allowed to be transported at all except in a freight car by itself. You cannot carry it on your person in a crude state if it is known, and the transportation of a sample, if a sample is required to be sent, even a small quantity, might be a serious matter.

Sometimes quite considerable quantities are imported and manufactured in different places in the country, and as I understand a sample must be furnished at some time or another if you are going to obtain a license.

Captain DESBOROUGH.—Fulminate of mercury is so well known that I think the chemical department would authorize it without examination. I cannot understand why anyone should want to carry fulminate of mercury in its crude state on his person.

Mr. HOWARD.—Except for a sample.

Captain DESBOROUGH.—We have a system in England by which persons are allowed to carry samples to the central office in London.

Mr. HOWARD.—Railways will not carry such persons here.

Captain DESBOROUGH.—I think that could be arranged.

J. J. RILEY, *Northern Explosives Company, Montreal.*—For my own part I am very glad to have an opportunity of coming here, and on behalf of my Company we welcome the fact that the Dominion is going to undertake the legislation which we felt was coming. We do not want provincial legislation with different laws and regulations in every Province. I had hoped we would have heard to-day something more definite than we have had put before us by Captain Desborough for discussion. There are various points he has dealt with very generally, but we have not had a chance to go into many matters. No doubt the details will be left to us later when we see the Bill. If we could have a draft outline, not necessarily the Bill itself, embodying the table of distances and other matters that we could study carefully, perhaps we could have expressed our views more clearly on this question. There are a great many things that will come up. For instance, one of the questions Captain Desborough mentioned, to try and get us lighter rates as they have in the States, the right to transport less than 5,000 pounds without paying for 5,000 pounds—such matters as that. Then there is the question of taxes to be raised, the cost of this testing station and bureau, and other important matters especially for small companies. The question of the cost of running a bureau must be considered. If we could possibly have, before this becomes a finality, some sort of rough draft, not necessarily the Act itself, we might have a better opportunity of studying it. While I say this, I do not wish to convey the impression that we are not favourable to the movement; in fact we are extremely favourable to legislation being prepared, but we have not had an opportunity of going into the details to-day.

Captain DESBOROUGH.—What I have been endeavouring to do in the Act itself is, to put in as little detail as possible, for this reason: if you put in detail you stereotype the practice, and that is bad for the industry and for the country. My view was, the Department would probably follow the English system, and when any change is made by Order-in-Council, the trade would be first consulted.

Mr. RILEY.—That from your point of view is extremely nice. If we had you here permanently carrying out the Act there would possibly be no trouble, but in this Act we are up against a difficulty of getting inspectors to carry it out.

Captain DESBOROUGH.—I quite admit that the administration of any Act depends very largely on the inspection staff, and I can only tell you I have spoken very strongly to Mr. Templeman on the subject, and urged him that he must really try to get the best men he can; and to do that he must be prepared to pay them

adequately. The other matter you have touched on, the matter of fees, I cannot suggest definitely what fees should be paid over here; but I am leaving behind me the scale of fees we have, and I am told they are extraordinarily insignificant; but whether the Dominion Government will be satisfied with an insignificant scale of fees or not I do not know. For instance, a factory license in England costs £10—less than $50—and is in perpetuity, so long as the terms of the license are observed. I understand a license in perpetuity is not considered advisable here, and it will be renewable each year.

Mr. RILEY.—Another point that does not seem to have been touched upon by Mr. McPherson, is the use of explosives. I agree with him that most of the accidents which have occurred have been in connexion with the use of explosives after they have left the factory. It is a difficult matter to tackle by legislation, and I would suggest the Government should deal with it as the other Departments do—for instance, the Dairy Department—by instructors.

Captain DESBOROUGH.—That is very wise.

Mr. LESUEUR.—Many of the men employed on construction works are foreigners who do not understand the language, and even if they did it would be hard to teach any of them who are over forty years old anything new. The instructors would find it difficult to teach an old dog new tricks.

Captain DESBOROUGH.—The Norwegian Consul has written to Norway suggesting that no more emigrants should come to Canada because they are being destroyed so quickly.

Mr. LOWERY.—In storing nitro-glycerine in the pure state, will a pound of it be considered equal to a pound of dynamite?

Captain DESBOROUGH.—No, I think nitro-glycerine should have a greater distance. It has been our experience that during the manufacture of nitro-glycerine the radius of destruction is greater. Nitro-glycerine is only used as a drug in England. It is a matter which will have to be discussed later on.

Mr. BRAINARD.—Is there any restriction on ordinary smokeless powder? Take ammunition factories—we have eight or nine types of standard smokeless powders. There is no restriction with regard to the storing of these in the one magazine, supposing it contains no higher explosive?

Captain DESBOROUGH.—No, we look upon them all as being equally dangerous, or if you prefer it, equally safe.

Mr. RILEY.—When will the Bill likely go into effect, and what time will you give us to conform to the Bill?

The CHAIRMAN.—That is still under consideration. This Conference is solely preliminary to the draft of the Bill, but as far as the administration is concerned I am quite sure that the Minister will be very glad indeed to obtain the ablest inspector that can be had. The administration is the important part of the whole thing.

Captain DESBOROUGH.—What limit of time would you think reasonable after which you would be required to conform with the new system?

Mr. BRAINARD.—I agree with Col. Riley that we would have to see the Bill and learn what detail is embodied in it.

Captain DESBOROUGH.—The Bill will have very little detail. It will simply say so far as licensing a factory is concerned that no explosives may be manufactured except in a licensed factory and the Minister of Mines will grant such license.

Mr. BRAINARD.—With regard to the time, all the eastern dynamite plants in Quebec cannot do construction work in the factory in winter. You have to keep the plant going and your building operations are restricted to the summer months.

Captain DESBOROUGH.—I do not want to tie you down to a definite time. If you say anything it will not be cast in your teeth afterwards; but would three years be enough?

Mr. BRAINARD.—I would rather have five.

Mr. RILEY.—Five years is better. It means constructing a great many buildings. For existing factories five years is little enough.

Mr. BRAINARD.—I do not know whether it has come to your notice or not, but the Bureau of Safe Transportation of Explosives in the States has been in consultation with the manufacturers for five or six months past, for the revision of the English distance tables. I have a copy of the list here—it is not made public yet—in which the results of the investigations are given as compared with the existing English laws. Before you go I should like to have the privilege of showing you this.

Captain DESBOROUGH.—I should like to have a copy of it. I do not look upon this table I have as perfect. It was drawn up thirty years ago and things have advanced very much since then. When you start a table of this kind it is difficult to alter it; but I do not think it is applicable to Canadian conditions as it stands. Personally I feel, as far as magazines are concerned, if you could evolve the perfect magazine which will not scatter heavy debris, it is quite possible the distances mentioned here could be materially diminished.

The CHAIRMAN.—I would advise you, gentlemen, to obtain all the information you can from Captain Desborough. You see in what a peculiar position we are placed. The Captain will sail on the 6th of October, and after that if any point comes up it will be necessary to correspond with him, and you know that is not a very satisfactory way of getting information. It takes a long time, and sometimes certain parts are misunderstood. The Conference is held for the sole purpose of enabling Captain Desborough to see how you feel with regard to his recommendations, in order that he may finally revise the draft Bill, made up last year. Therefore, I shall be very glad indeed if you will ask any questions that occur to you, and inform yourselves, as far as you can, as to the character of the Bill.

Captain DESBOROUGH.—With regard to the table of distances, I did not propose that any table of distances should be definitely incorporated in the Bill. What I wanted was, that the licensing of factories should be carried out on the general principle that the quantity of explosives allowed to be in a building depended upon the distance of the building from other buildings. I may say the Germans have recently issued new regulations which practically adopt this particular table.

Mr. MCPHERSON.—I should like to say this meeting has been called for the purpose of absorbing what Captain Desborough has explained. The difficulty I find is that while we have his exposition of his position, we have nothing we can study over. If we have something definite before us, we can state our objections or otherwise. Many questions will occur to us after this meeting has adjourned, which

at the moment do not come to us, because we have nothing in black and white that we can study as a basis. If we had something to look over we could see the position distinctly, and it seems to me it would advance the matter very quickly if we could have before us something like a synopsis of the Bill. With such a statement before us, we could come back with quite a budget which could be discussed here. I do not know if there is any draft of the Bill of last year, or whether it could be submitted to us.

The CHAIRMAN.—The Bill which has been drafted, only gives general powers, and contains scarcely any detail. All the detail belongs to the administration; that is to say, when new regulations are to be made, authorized by the Bill, it will be done by Order-in-Council. There will be plenty of opportunity given the parties affected by such Order-in-Council, for consultation. I do not think the draft Bill would tell you anything specially. All the main points will be administration affairs and Orders-in-Council, and you will have plenty of opportunity to be consulted in the matter. The Bill is in the hands of the lawyer solely for the purposes of ascertaining how far the Dominion Government can go, without interfering with the Provincial authorities. It will be a very short Bill, indeed. Some matters that Captain Desborough has presented to you are the vital points which he is going to recommend, and I am very anxious that you should ask him every question that affects you; because on this will be based his final report to me. We cannot proceed in any other way; it is utterly impossible for me to take any other course. The Bill does not belong to me, but to the Minister. I am very glad one particular point was mentioned: it is better to have no law than to have a law poorly administered. This subject is of such a technical character, and of such vital importance that it is necessary to have the very ablest and best man available, at the head of the inspection. The question of salary arises. The salaries offered by the Government are too low to tempt anyone with special ability to accept the position; but in this case an exception ought to be made.

THOMAS GIBSON, *Deputy Minister of Mines for Ontario.*—The discussion upon this matter has proceeded so far, almost entirely from the point of view of the manufacturers of explosives. I assume that most of the gentlemen present in this meeting are manufacturers of explosives, or represent manufacturers of explosives. I had the honour to receive an invitation to attend this Conference, and I am very glad indeed to be here. I wish to say at the outset, that so far as I can speak for the Government of the Province of Ontario, they are heartily in sympathy with the decision of the Dominion Government to legislate upon this matter. In fact it has been the view of the Bureau of Mines in Ontario—and I think the view of a good many of the mine owners of Ontario—that in this question of explosives, the supervision of manufacturing has been left too long in abeyance, and that the time has fully come when some step should be taken to put it in a more satisfactory position. At the root of all legislation in Canada, as the Chairman has pointed out, lies the question of what jurisdiction does the proposed legislation come under. We have a Federal system, the Government of the Dominion of Canada; and the governments of the several provinces of Canada; and the constitution of our country divides the jurisdiction between the Parliament of Canada and the various local legislatures. It would be not only inadvisable, but it would be useless to attempt to disregard these fundamental provisions of the constitution of our country in any

legislation whatever. In this legislation, as it has been roughly suggested, so far, undoubtedly questions of jurisdiction will arise. I am not here to say what the position of the Government of the Province of Onatrio will be with regard to any legislation until that legislation is before us. I have not any doubt, whatever, that the legal adviser of the Dominion Government in connexion with this proposed legislation will take the utmost care to preserve the spirit and letter of the constitution in regard to the powers and functions which belong to the central government, and those which belong to the local government. It would seem to me a reasonable division if it could be on these lines: that the supervision of the manufacture of explosives, and the supervision and inspection of distributing magazines should be in the hands of the Dominion Government, and subject to Federal legislation.

That is a matter of trade and commerce, as I understand it, and so long as the explosive remains in the form of a commodity which is open to purchase and sale: then I think it is and ought to be subject to the supervision and jurisdiction of the Dominion Government and Parliament. It is somewhat different when you come to put that explosive into action, when you carry it into the quarries, the mines, or whatever work it is to be used for. The question of the use of explosives, how they should be used in mines for instance—I speak of mines and quarries because they come under the Department to which I belong—these have been regulated in the past by Provincial legislation. There seems to be no doubt that the Provinces have power to enact such legislation. I do not suppose for a moment that the Dominion Government will attempt to trench on that ground of jurisdiction. The use of explosives in mines differs from the use of explosives in public works: for instance, such works as the construction of railways, in which large quantities of explosives are used. The great majority of the railways are under jurisdiction of the Federal Government, but the mining lands of the Provinces belong to the Crown, as represented by the Provinces. They are sold by them, and in the legislature of these several Provinces, lies the power to enact such legislation as they may desire to attach to any lands, or mines, or quarries in these various Provinces. I only wish to make the point clear so that there may not be any misapprehension on the subject. This is not a matter, I assume, which very vitally concerns the manufacturers of explosives, except in this way, that whatever legislation is enacted must be authoritative legislation, and must be enacted by that government to which, under the constitution, such powers and functions are assigned. Otherwise the legislation will be ineffective and at the mercy of those whom it is intended to stop, if they should choose to oppose it and defend it in the courts. Should a matter ever come before the courts they will undoubtedly decide whether the legislation is constitutional or otherwise. There are two matters of public importance which might be achieved by legislation of this kind. I do not say this with any intention or desire to reflect on the manufacturers of explosives in Canada. I think there is a possibility of improvement in all things, and I have no doubt it is possible to improve the character of explosives which are used and manufactured in our own country. If the legislation will enact that factories for the manufacture of explosives in Canada are to be subject to supervision, and that supervision is the right kind of supervision, it will have a tendency to improve the quality of explosives, and will be a guarantee to the man who uses the explosive that he is getting what

he thinks he is getting; that he is not getting 35 or 40 per cent dynamite, when he is paying for 50. That will have a tendency—by improving the quality of explosives—to lessen the number of accidents which occur in our mines. It is undoubtedly true, and distressingly true, that we have too many accidents in our mines. How many accidents are due to the inferiority of explosives or to the negligence, incompetence, or ignorance of those who use the explosives is a matter I am not prepared to decide, and which I fancy will be very difficult to determine, but anything that can be done in the way of improving the situation will be generally welcomed. The point of view I look upon it from, is of necessity different from the point of view you gentlemen look upon it from. What the Government of Ontario has in mind is the improvement of conditions in our mines, and especially the safety and health of those employed in the mines. If this legislation is of such a character as to improve conditions in that respect, it will have the sympathetic and hearty co-operation, so far as I am able to pledge it, of the Department which I have the honour to represent. (Applause).

Mr. BRAINARD.—I know it is quite impossible to get a draft of the Bill, but could we not adjourn for a few days and in the meantime have copies of the minutes of this meeting sent to us, and we could then hold another general meeting?

The CHAIRMAN.—Copies will be sent to every one who is here to-day. I may explain that Captain Desborough has been travelling all over the country. He was to have sailed on the 16th of this month. We cabled asking permission to have him remain with us a little longer—for I did not know exactly when Captain Desborough would be back and when we could hold a Conference—and he has been allowed to stay until the 6th of October.

On motion, the meeting decided to adjourn, and to hold another Conference a week hence (September 30, 1910).

The meeting then adjourned.

(*For Report of Proceedings of adjourned Conference, see page* 204.)

ADJOURNED CONFERENCE ON PROPOSED LEGISLATION TO REGULATE THE MANUFACTURE, IMPORTATION, AND TESTING OF EXPLOSIVES.

ROOM 16, HOUSE OF COMMONS,
OTTAWA, September 30, 1910.

The Conference resumed at 10 a.m., Dr. Eugene Haanel, Director of Mines, in the chair.

There were present:—
Captain Desborough, H.M. Inspector of Explosives, Home Office, London.
Joseph G. S. Hudson, Mines Branch, Department of Mines.
E. T. Corkill, Inspector of Mines for Ontario, Toronto.
William McMaster, President Hamilton Powder Company, Montreal.
J. Murray Wilson, Manager Hamilton Powder Company, Belœil Station, Que.
A. E. Blood, Bureau Safe Transportation of Explosives, New York, Toronto.
Daniel Smith, President Ontario Powder Company, Kingston.
C. A. McPherson, Secretary Ontario Powder Company, Kingston.
H. R. Drackett, Superintendent Standard Explosives Company, Vaudreuil.
Jas. J. Riley, Vice-President Northern Explosives Company, Montreal.
E. A. LeSueur, Ottawa.
Lionel Kent, The Energite Explosives Company, Montreal.
Mr. Gallagher, Standard Explosives Company, Vaudreuil.
Col. William White, Ottawa.

The CHAIRMAN.—At the last meeting, which was held on the 23rd of September, the parties interested in the proposed legislation on explosives heard the recommendations of Captain Desborough, which he is to make to the Government; in connexion with the drafting of the proposed Bill. It was thought desirable that an opportunity should be given to the parties who were then present to digest what he said, and to prepare themselves to ask further questions at an adjourned meeting. We are here this morning for this purpose, and if you have any further questions to ask, or if you desire to discuss with Captain Desborough points which may have come up in your minds with respect to the proposed Bill, I shall be very glad if you will proceed to do so. A desire was expressed at the meeting held on the 23rd inst. that copies of the proceedings should be sent to those present on that occasion. We had less than a week to get that report out, but copies were mailed, and I hope you received them in time to enable you to read the report, and digest it. Captain Desborough desires me to mention that he has a recommendation to make, in connexion with the appointment of a committee to consider the best type of magazine construction, and I should like to hear from him on that point.

Captain DESBOROUGH.—Dr. Haanel and gentlemen: I am recommending to the Mines Department that they should consider the advisability of forming a small committee: consisting of a member of the Mines Department; possibly an officer from the Militia Department who is interested in the storage of explosives; one member of the Public Works Department—who would be an expert on buildings, and two representatives of the explosives trade. I should suggest that the explosives trade be prepared to supply a limited quantity of explosives for these experiments, and that the experiments should, in general, consist of putting up three or more types of magazines, and then exploding say a ton of explosives in each, and noting the effect of the explosion, more particularly with regard to the projection of debris. The types of buildings I would suggest to be experimented with are: (1) the expanded metal with a cement plaster; (2)—if I can procure the details—the German specially reinforced concrete; (3) a log magazine; and (4) and (5), any particular types which the committee think desirable to test. In carrying out the experiments, I think the explosive should be placed at one end of the magazine, leaving as much air space as possible between the explosive and the far end, the idea being that the explosive which is close to the wall will shatter that wall, but it is not at all certain that the wall at the far end will be equally shattered. When these experiments are being carried out, particularly with regard to expanded metal and reinforced concrete, it might be advisable to see if the expanded metal and iron in the construction of reinforced concrete could not be utilized to protect the buildings from lightning. The other main point that the committee should bear in mind is that the magazine should be reasonably secure against unlawful entry, and also that the cost of construction should be as economical as possible.

Mr. JAMES J. RILEY, *Vice-President, Northern Explosives Company, Montreal.*—Will Captain Desborough be good enough to outline to us his views on an ideal construction for a powder factory? Probably some of us have to do a little building even this autumn or before the new legislation will be operative, and we would like to have Captain Desborough's ideas of what we should strive for.

Captain DESBOROUGH.—I am afraid that is too big a proposition.

Mr. DANIEL SMITH, *President of the Ontario Powder Company, Kingston.*—I should like to ask Captain Desborough if he has had much experience in brick magazines. I have always been of the impression that brick is the best material for such a building, because if an explosion takes place the brick is pulverized into dust. If the magazine is constructed of stone the explosion will scatter it like cannon balls. I have seen magazines where the door of the magazine, made of iron, was used as a target. A brick wall one foot thick will keep any bullet out. I do not know so much about iron and concrete.

Captain DESBOROUGH.—In England all our magazines, except floating magazines, are made either of stone work or brick work. We have had only two occasions in the last forty years in which explosions have occurred inside a magazine. In one case the magazine was filled with ten tons of sporting powder, and it burned away harmlessly. In the other case the magazine contained a ton of black powder and 150 pounds of gelignite. In this case there was a very violent explosion, and bricks were projected a considerable distance.

Mr. SMITH.—I know of only one case, which occurred in Brockville a number of years ago, where there was an explosion in a small factory. In that instance the brick chimney was pulverized into dust, while the stones in the building were thrown all over the field.

Captain DESBOROUGH.—I have the experience of only one magazine. There was another case where the explosive was stored in a concrete building belonging to the British Government, near Woolwich, in which an explosion occurred; but the magazine was divided into six compartments by very substantial concrete walls. The explosion occurred in one of the compartments, and pulverized the concrete in its immediate neighbourhood. The further walls of the other compartments were projected in blocks, some of them weighing half a ton, a distance of 700 or 800 yards, so it seems that the ordinary concrete is a very bad form of construction. I will try and find a report of the experiments I mentioned the other day, which the Germans had been making with specially reinforced concrete. If I can procure it I shall send a copy of it here. I first saw a short abstract of it in the Journal of the Society of Chemical Industry in England. I may say I am a very great believer in putting earth banks around magazines. They prevent a good deal of the debris being projected, and also very considerably arrest the wave arising from an explosion. We heard, I think it was last week, of an experience with a magazine in British Columbia which was built of logs, and surrounded with, I think, about two feet of earth. This was in the middle of a forest fire where everything else was absolutely wiped out, but the magazine remained, and the explosive inside was not damaged in any way, not even by the heat of the fire passing over the roof.

Mr. SMITH.—We have had some experience with several magazines in this new territory to the north. For instance, at Sudbury, twelve or fifteen years ago, a company had a magazine built of logs and covered with earth. A fire came and the man fought it, and it was safe so long as the fire did not touch it. Being covered with earth, it was protected.

Captain DESBOROUGH.—I do not like to tie you down to any hard and fast structure. A magazine which would be suitable in one place might be unsuitable in another. The object I have tried to attain in assisting to draft this Bill is to include as little hard and fast regulation in the Act as possible, but to have all the regulations administered by Order-in-Council, so as to allow plenty of scope for differences of conditions or material.

Mr. J. MURRAY WILSON, *Manager Hamilton Powder Company, Quebec.*—Last week Mr. Drackett, of the Standard Explosives Company, asked if a plant were located in heavy bush, whether that would count as a natural protection instead of embankments, and you replied that there was no guarantee that the timber protection would be there permanently, that if the timber should be destroyed there would be no protection afforded, and that, that is why timber is not taken into account in connexion with measuring distances. As soon as the underbrush is cleared away, so that there is no danger from fire, I think trees are the very best protection. You agreed that they are, and I do not think any explosive factory would deliberately clear away trees which are so good a protection. The trees grow larger every year, and are even a better protection than embankments. I think trees ought to be taken the same as mounds or hills—should be taken as equivalent to an embankment.

Captain DESBOROUGH.—I agree that trees do intercept a great amount of debris projected by an explosion. If Mr. Wilson were always managing a factory so protected it might possibly be advisable to take into consideration the fact that trees are there. On the other hand, there are a number of factory managers who dislike trees very much. They say that they prefer to have the buildings quite open, where they can see what is going on. I do not think there is much in that myself, but there are people who do hold those opinions.

Mr. H. R. DRACKETT, *Superintendent Standard Explosives Company, Vaudreuil.*—Would not a mound shut off the buildings from view very much the same way as timber? In fact, if the mound were on all sides it would perhaps shut it off still more.

Captain DESBOROUGH.—The mound does shut off the buildings from view, but does not shut off the ground between the buildings, and the idea is that the manager of the factory wants to see when an explosive is being transported from one building to another. There is another point about trees, how are you going to settle what growth of trees will be accepted?

Mr. DRACKETT.—I should think from what you have said that the Act will be administered by the head of the department, and that would be a matter for his judgment in each case, of course. Last week I asked some questions about the use of timber growth as a protection, and I find that our timber growth has been standing within the memory of the oldest inhabitant, and probably will stand for some generations, because we are very careful of our timber growth and nurse it along at all times.

Captain DESBOROUGH.—Then if the trees were taken into consideration I suppose you would see no objection to inserting a clause in the license that the distance should only be considered adequate so long as the trees were standing.

Mr. DRACKETT.—Certainly that would be accepted, I think. We would not expect to take any advantage of the fact that where we have timber growth we could cut it down and do away with our protection.

Captain DESBOROUGH.—Timber is getting more and more valuable.

Mr. DRACKETT.—If we had to erect mounds it would be quite an expense for us where we have already a very efficient protection, because our ground is all rock. We would have to bring in enough dirt from some outside point to make mounds there.

Captain DESBOROUGH.—I was principally referring to magazines when I spoke of mounding, and not to working buildings. What was really in my mind was the outlying magazines, what I should call distributing magazines.

Mr. DRACKETT.—In a case like that the greatest danger is they are considered to be outside the buildings.

Captain DESBOROUGH.—I agree.

Mr. DRACKETT.—In that case, perhaps, the timber would be a source of danger through fire.

Captain DESBOROUGH.—I quite agree.

Mr. DRACKETT.—But in construction it is altogether a different matter, it seems to me.

Mr. C. A. MCPHERSON, *Ontario Powder Company, Kingston.*—It seems to me that trees surrounding a magazine in the outlying districts would serve to keep the

public at a distance, and to keep private dwellings away, so it occurs to me that trees would be a very good protection, not only as a barrier against falling debris, but as a means of keeping people from building close to the magazine. It might be well to consider it in that respect.

Captain DESBOROUGH.—Yes, except I do not think it was ever suggested that the existence of trees would be a bar to the establishment of a magazine. I think we are at cross purposes.

Mr. MCPHERSON.—It occurs to me that while trees are considered a good natural barrier, they should be regarded also as a barrier to the building of houses nearer the magazines.

Captain DESBOROUGH.—As far as dwelling houses are concerned a magazine should only be allowed to exist, containing a specified quantity, so long as the distance required between the magazine and dwelling houses is maintained. If a property owner had a right to build a house alongside a magazine, and proceeded to build it, then the magazine license would become extinct.

Mr. DRACKETT.—That raises a very important point. For instance, a distributing magazine might be built in some district in conformity with the table of distances; that being the case would the owner of the magazine have any guarantee that your bureau would protect him from the encroachment of dwellings?

Captain DESBOROUGH.—No.

Mr DRACKETT.—Suppose we put up a magazine for explosives and some one undertakes to build near it, I suppose the only way we could protect ourselves would be by purchasing the land near the magazine to prevent any one coming in.

Captain DESBOROUGH.—As a rule, the effect of building a magazine is to prevent the erection of other buildings near the place.

Mr. DRACKETT.—It has not always been the case. I think Mr. Smith could give you some light on that point. We were just discussing it last night. If you have fifty tons in a magazine, you must have a distance of 850 yards. Is that correct?

Captain DESBOROUGH.—If you get the consent of the occupier the full distance is 850 yards, but if you have an earth bank between the magazine and the dwelling house the distance may be reduced to 425 yards, or if there is a substantial natural feature between, then the distance would be about 216 yards.

Mr. DRACKETT.—Say we do not receive permission, we must, therefore, put our buildings 850 yards from other buildings. That means a square mile of property.

Captain DESBOROUGH.—It would be necessary then to put up an earth bank, which would reduce the distance.

Mr. DRACKETT.—That would still be half a mile.

Captain DESBOROUGH.—I do not quite see how to get around that. The way our people get around it is, they use a fairly large number of small magazines—20-ton magazines. You must remember in England we are very crowded, and it is difficult to get a site for a magazine at all, but still we manage to use 30,000,000 pounds of explosives every year, and all that is kept at specified distances. I do not think in practice you will find the difficulty you anticipate.

Mr. SMITH.—A few years ago we built a magazine in Cobalt, when the mines were first discovered there, and we cut a road about half a mile into the woods and built a log magazine covered with sheet iron, banked it, and fixed it up as we

thought was right. That autumn the discovery of silver was made known generally. Miners went there in flocks, and went in by our road and built a town near the magazine. A bush fire came. They did not pay much attention to it until it got near the magazine, and then they made tracks down the railway. The country being new, and there being veins in the rock, leaves accumulated in them and the fire followed them up, and ran under the magazine and set it off. You have heard of the explosion, I presume?

Captain DESBOROUGH.—Yes.

Mr. SMITH.—In a mining district like Sudbury, you cannot buy a large block of land—the Ontario Government would not sell a mile square—and the consequence is we could not build a magazine there where it is quite essential. The quantities stored vary. Sometimes we have to carry a larger stock than at other times in those isolated places, and if we should have a large quantity it would be necessary to move the magazine farther away than when a small quantity is stored. In that event it would be necessary to have the magazine on wheels or runners.

Captain DESBOROUGH.—Cobalt cannot be described as a flat plain, and I am quite sure there are many hollows in the ground that would enable you to maintain a quarter of these distances. I think, possibly, Cobalt may be an exception. Perhaps it would be better for Canada if it were not, but you cannot expect to have tremendous developments in such a rich country in very many places.

Mr. SMITH.—You were speaking of trees as a protection. We find that the trees are a great protection, not only against flying debris, but also against carrying the sound. If an explosion occurs in such a place the trees around it throw the sound up. For instance, if you see a train approaching, and stand behind a clump of bushes until it passes, you do not hear much sound.

Captain DESBOROUGH.—I quite recognize the very great value of having the protection of trees.

Mr. SMITH.—Our factory stands in a very nice clump of trees. We have had a couple of explosions there, and I consider the trees afforded very good protection. It is the wave that does the damage, the movement of air, and the trees carry the waves upward.

Mr. LIONEL KENT, *the Energite Explosives Company, Montreal.*—Mr. Smith's remarks on the subject of the advisability of having trees surrounding magazines and factory buildings recall to my mind the differences in point of view taken by some of the municipalities on that subject. Our factory is situated in the township of Bucke, near Haileybury. Under the municipal regulations there we are not allowed to have trees or brush within some twenty rods of any of our buildings or magazines, and for that very reason we have been compelled to clear them away, the danger arising from bush fires in that district not being considered by any means insignificant. Before getting away from the subject of the construction of magazines, I notice Captain Desborough, that you make mention of sheet-iron magazines as having been adopted in England or in use there.

Captain DESBOROUGH.—We do use them in England, but every one I have mentioned them to here, says that, owing to climatic conditions, they are unsuitable. I do not see the slightest objection to using corrugated iron buildings in a certain way for magazine construction.

Mr. KENT.—The only objection you have heard is that climatic conditions render them objectionable at certain seasons of the year?

Captain DESBOROUGH.—Unwise.

Mr. E. A. LESUEUR.—You mentioned 850 yards as the distance required for a magazine containing not more than 50 tons.

Captain DESBOROUGH.—With the consent of the occupier.

Mr. LESUEUR.—Without the consent of the occupier what would the distance be?

Captain DESBOROUGH.—Three thousand five hundred yards, that is unmounded, but it is almost inconceivable that you would find 3,500 yards of flat country in the Sudbury district.

Mr. MCPHERSON.—Some mention was made at our last meeting of a revised table of distance. I do not happen to have one of those tables. Is there any probability that the revised tables will be adopted?

Captain DESBOROUGH.—I cannot tell you what the Dominion Government will do in the matter, but I think that I may say this, that the new table is produced by the manufacturers of explosives. I do not doubt their integrity in the least, but one must remember they are very interested parties and, therefore, before one accepts such a table one would have to be very well satisfied that the distances were adequate. I may say, in the new revised table sent to me it was expressly stated that the new distances did not protect any building against projection by debris. It is very nice from the manufacturers' point of view; but if the Government sanctioned such conditions as might occur similar to what did occur in Hull, I think the Government would have a very unpleasant time, and rightly. The existing table of distances has been adopted by the bulk of the European countries, by South Africa, by Australia, and by India, and if the new one were adopted, reducing these distances about 75 per cent straightway, I think it would be a very bold step to take.

Mr. MCPHERSON.—In your opening remarks you suggested that a committee should be formed of three Government officials and three representatives of the explosives trade, for the purpose, apparently, of experimenting on this question. The present table, therefore, would probably be adopted temporarily until such time as a new table might be arranged.

Captain DESBOROUGH.—My view was not so much to deal with the table of distances as to afford information about preventing the projection of debris. Remember in this country your dwelling houses, outside of the cities, are almost entirely frame houses. These are much more susceptible to damage than buildings of stone or brick which you find in other countries. Therefore it is absolutely essential to take such steps as you can to minimize the damage which would occur from debris in case of an explosion. I would not like to base the distances on experiments with one ton of explosives—I would not like to say that it would indicate what might happen if 50 or 100 tons of explosives were exploded. I do not think the manufacturers would care to furnish 100 tons to be exploded at one time; it would be an expensive experiment to carry out.

Mr. McPherson.—The Government might co-operate and furnish the explosives. It occurred to me that up to the quantity exploded it might be well to have a revised table in mind, to govern such quantities as might be experimented with.

Captain Desborough.—You may be very wealthy people out here, but if you are going to use enough explosives to make tests on a large scale, I think you will find it very expensive.

Mr. McPherson.—Up to one ton was suggested.

Captain Desborough.—That is a very small amount.

Mr. McPherson.—It would be interesting to manufacturers to have experiments on a large scale. Apart from our magazine, and perhaps one other building on the works, we would not expect to have 100 tons in any one of the buildings. Then it would be interesting to us to know just what distances might be considered safe.

Captain Desborough.—I have been endeavouring to get the English Government to carry out such experiments for the last eight years, and have failed to persuade them. I mentioned it this morning in the hope that you people would be ready to co-operate with the Dominion Government. I think the experiments would be most valuable, particularly if carried out in a reasonable way, keeping economy in view.

Mr. McPherson.—Economy would be, of course, one determining factor. For instance, if we have regulations put into force here which will mean that we will have to transport our material back and forth, let us say a quarter of a mile between the different buildings on the work, it means that our finished product is going to cost a great deal more than the same explosive manufactured in the United States, where the regulations may be entirely different. I do not know if they are. Supposing our cost is increased by even a fraction of a cent in the pound, where we have certain markets where we come into competition very keenly with the United States dynamite, I imagine in those conditions we might be entirely shut out.

Captain Desborough.—If my recommendation is adopted no United States explosive will come into Canada, except by virtue of an importation license. The United States manufacturer will be required to have his explosive authorized in the ordinary way. Any explosive coming into Canada will be held in bond until samples have been examined by the chemical officers of the new department, and it will not be released for distribution until the chemical advisers have reported favourably on the samples taken by the customs officers.

Mr. McPherson.—I have reference more especially to another of our colonies where there is no protection or duty of any kind, and where we have to compete with United States dynamite. They probably will not have any regulations of this kind, but the explosives used there will be either Canadian or American. If we are handicapped to the extent of even a small fraction of a cent we will be cut out of that market, which we consider peculiarly our own, so that if you can in any way reduce the distance between buildings on the works, it is a very important point to the manufacturers where others may have an advantage in the trade. I merely mention it in order that these questions may be taken into consideration.

Captain Desborough.—I have here the intra-table of distances which we use. The distances are very much smaller inside the factory than in relation to buildings

outside. For ordinary blasting explosives, if a building is mounded you can have 50,000 pounds at 75 yards. I do not think there are many working buildings where you will want anything near 50,000 pounds. The distance for 2,000 pounds, if mounded, is 50 yards.

Mr. RILEY.—What is the distance for 5,000 pounds?

Captain DESBOROUGH.—The curve is very steep between 2,000 and 10,000, but you can have 10,000 pounds mounded at 55 yards.

Mr. RILEY.—And half of that?

Captain DESBOROUGH.—Five thousand would come between 55 and 50 yards.

Mr. MCPHERSON.—There is one question which came up in connexion with our last discussion, that is, the sampling of new importations. We are not interested in that, so I do not need to discuss it. I do not think we quite understand each other on the question of this licensing. As I understand it, you stated that any powder imported from the United States would be subject to a license. It is a question of cost rather than license that would determine where the trade would eventually lie.

Captain DESBOROUGH.—I do not think you will find a government in the world that will grant a license without extracting a fee, and probably the fee will be made proportionate to the quantity of explosives imported.

Mr. MCPHERSON.—The Ontario Powder Company did not receive the documents which were to have been sent to them. I believe they were mailed, but we were obliged to leave Kingston probably before they arrived, so we have had very little time to study the points touched on last week. In regard to the number of employes in the different buildings, I notice you mention here the rule in England at the present time, or is it merely the conditions you have found in Canada?

Captain DESBOROUGH.—As regards the limitations?

Mr. MCPHERSON.—The number of employes in a building.

Captain DESBOROUGH.—That is in England. The number is generally limited to four, but that is exclusive of what we call runners; those are men who are not producers and whose business it is to convey explosives from one building to another, and, of course, exclusive of foremen.

Mr. MCPHERSON.—At our last meeting you made some remarks with reference to the applicant drafting a license. I do not just understand what that means.

Captain DESBOROUGH.—It means the occupier of the factory. He has theoretically to produce a draft of the license and bring it to the authorities and ask them to confirm the license. The explosives department in England have so much greater experience in the way of drafting licenses that they practicaily draft the license with the occupier of the factory. It is merely a friendly arrangement; it saves trouble to the occupier of the factory.

Mr. MCPHERSON.—That seems the natural course and it must necessarily resolve itself into that.

Captain DESBOROUGH.—The essential part of a license is the plan, which shows the distribution of the buildings on the site. I may say I have here a dummy license which we use in England, and which you might like to have a look at. I am not proposing that it should be exactly the same for Canada.

Mr. McPherson.—On page 8 of the report of last week's meeting mention is made of regulations to be made by the Railway Commission for transportation by rail, and regulations for the transportation by road, and by water.

Captain Desborough.—What I said was that it was not proposed to interfere with the transportation by railway, as that was already governed by the Railway Commissioners' regulations, but I did think the Federal Government should make general regulations regarding transportation by water, and by wagon road. There was a very bad accident in one of the cities of the United States through bad stowage on a cart. Two cases of dynamite were dropped off a cart and an electric street car ran into them. You want to protect the public from bad stowage, and what we propose is that general regulations should be made providing that stowage should be satisfactory.

Mr. McPherson.—Subject to a chance inspection at any time, that is, to one you never know. In some cities, I understand the regulations are such that if you want to remove powder from a magazine you have to apply to the Chief of Police, who sends an officer to accompany the load. That means not only expense, but inconvenience.

Captain Desborough.—And a certain amount of friction, too.

Mr. McPherson.—A regulation of that kind in this country would be tremendously resented, and in the end might not be workable.

Captain Desborough.—You think a general regulation would be a mistake?

Mr. McPherson.—A general regulation might be satisfactory, but to stipulate that an officer in uniform must accompany the carter, as is required in some cities, would never do.

Mr. Smith.—Quebec, for instance.

Captain Desborough.—We have nothing of that sort in England. All our regulations are really to require proper stowage; that is the gist of the regulations, and also to prevent gasoline and similar things being conveyed with explosives. The difficulty here is that many of the municipal authorities have power to regulate matters. In one instance it has come to my knowledege that they have insisted upon every vehicle conveying explosives being provided with rubber tires. That is not a thing which I should have thought necessary, but at present apparently they have the power to do so. My feeling is this, if you can get general regulations it will be much more satisfactory to you and to the public.

Mr. McPherson.—Major Riley at our last meeting in connexion with the supervision of the use of explosives suggested that a course might be followed something like the one followed by the Agricultural Department, that is, sending out instructors. That reminds me of the system pursued with respect to the inspection of milk. As a matter of fact, the inspection of milk does not occur every day, or periodically, but the produce of every dairy is subject to inspection at any time. In the same way a rule might be adopted that the whole system of stowage is subject to inspection around the corner at any place, and in that way people would be more careful, and such inspection would be more effective than any other.

Captain Desborough.—To get that inspection you must have inspectors appointed, and it seems to me to be largely a question of money.

Mr. McPherson.—The local police might co-operate.

Captain DESBOROUGH.—If their co-operation could be obtained. That is what is done in England. The entire supervision of conveyance is absolutely in the hands of the police in England.

Mr. MCPHERSON.—On page 10 of the report of our last meeting I find a reference to accidents from frozen explosives. That comes back to what I mentioned the other day, the question of accidents at the place of use. I do not think we have accidents from frozen explosives at the factory.

Captain DESBOROUGH.—No, that refers only to the use.

Mr. MCPHERSON.—If an explosive is used in the frozen condition at the point of use, that is where the inspection should be; you cannot blame the manufacturer. Then again, the statement is made that accidents happen from the use of weak or poor caps. That no doubt is true, but on investigating at the point of consumption our experience has been that most of the accidents we have been able to trace have been due to improper loading, or probably carelessness in preparing their charges. They may have one cartridge in the bottom of the hole, and a large space between that cartridge and the next one, the consequence being that the top cartridge would go off without exploding the lower one. Then when they come along with their picks and shovels they find the lower cartridge unexploded. That is not due to inferior dynamite, but to improper loading.

Captain DESBOROUGH.—I have studied the use of explosives for some years, and I would not be wrong in saying that 80 per cent of the accidents which occur in use are due to sheer foolishness on the part of the operator.

Mr. A. E. BLOOD, *Bureau Safe Transportation of Explosives, New York and Toronto.*—I should like to touch on a point brought up with regard to the transportation of explosives by team through cities. I do not think there are regulations at the present time that fully cover the matter, and that is, the transportation of blasting caps and high explosives on the same wagon. Without giving any offense I should like to say that that practice is pretty general among the representatives of the manufacturers in Canada. It seems to be a point that has been overlooked entirely. They have perhaps certain days of the week in which they want to deliver their shipments to the railways, and also deliver to the local works throughout the district, and it is almost entirely the practice to load the whole business in one wagon, and make the deliveries just as a groceryman would deliver his groceries in the morning.

Captain DESBOROUGH.—I think the regulations, if they were enforced, would stipulate that caps should not be conveyed with explosives.

Mr. BLOOD.—What I am asking is that the manufacturers discontinue the practice before the legislation is passed. I leave it in their hands.

Mr. CORKILL.—Would that have reference to the transportation of explosives from the magazines to the mine itself, or is it chiefly transportation in cities?

Captain DESBOROUGH.—My idea is, it should be where the explosive can constitute a danger to the general public, but when the explosive goes on to the mine premises, then the mine owner is responsible for it. As a matter of fact, these general regulations should be only what one might call common sense, and the mine owner would be well advised to carry out the same regulations when the explosive is on his own property.

Mr. CORKILL.—I quite agree with you as to the reckless manner in which explosives are transported. I know of a great many cases that were really dangerous. One happened in Cobalt. The teamster had taken his load of dynamite, and at noon time he happened to be opposite a public school. He allowed his load to remain there with children playing around it for over an hour. Such a thing should be stopped.

Captain DESBOROUGH.—One of the regulations we have is that the man in charge of the team should not smoke when passing through a town or village. That could not hurt any one, and still it is a most important precaution to take.

Mr. LESUEUR.—The minimum carload of dynamite is ten tons—that means about eight tons of actual dynamite. Magazines are built for containing one of these shipments, and it occurred to me that it might not be too much, if the Government thought it would alter their views about the table of distances, if the manufacturers would supply not merely ten tons, but two or three lots of ten tons each to experiment with the different types of magazines, with a view to finding out whether there was any possible danger from debris from a well constructed magazine without rubble in its walls, at distances such as the British table of distances gives. Do you not think that the data obtained from such experiments should have great weight in determining the distance that a magazine containing not more than ten tons might be located from the nearest dwelling?

Captain DESBOROUGH.—A practical experiment is just what I was suggesting, only I was too modest. I stipulated for one ton, and you are stipulating for 10 to 100 tons.

Mr. LESUEUR.—The matter is of such vital importance and involves such an investment in land that the expense would be warranted; but no one concerned might wish to incur the expense from which others who did not share it would derive as much benefit as himself. I should think there would be no trouble getting several times ten tons from the manufacturers if they would club together.

Captain DESBOROUGH.—It is an excellent idea. What I suggest is to carry out the experiment with two kinds of explosives. Take ordinary black powder for one, having a low velocity, and for the other an explosive which has the greatest speed of detonation, something like 60 per cent dynamite, and then if you have the two extremes of velocity of explosion, you can be sure what will happen with intermediate explosives.

Mr. J. MURRAY WILSON, *Hamilton Powder Company, Quebec.*—I would be on the economical side. The mine manager can always tell how much a ton of explosive will do in the way of work. He can tell if the explosive is weak or strong. We can tell in the laboratory whether the explosive is weak or strong. Why not make small magazines as you suggest, say only about 6 feet square, and instead of exploding ten tons, explode a decimal quantity of that, or say ten pounds, and you could have a number of experiments to show where the debris goes.

Captain DESBOROUGH.—In actual practice we have made these tests and have registered results. We have found the curve for small quantities does not give a very good idea of how the curve will go as the quantities increase. It changes very rapidly, and I would not like to base a new table of distances on experiments carried out with small quantities.

Mr. Wilson.—I am speaking more of the quality of walls so as to get the best type of wall for a magazine in the event of an explosion. It would only be a comparative test.

Captain Desborough.—Only a comparative test at best, but I think if done without undue expenditure to the country half a ton or a ton should be used, and it would be better still if you made tests with larger quantities. It would be more satisfactory to every one. One does not really know what pressure would obtain with large quantities. The only time in which I have attempted to measure pressure was firing a charge of 75 per cent dynamite in a cannon. We used copper crusher gauges, and the result of these tests gave us say 100 tons to the square inch. I do not give those figures as at all accurate. We do not know what happens to copper after that pressure. The other system of measuring pressures was in vacuo. I do not think those experiments were worth anything.

Mr. Corkill.—I have not had an opportunity of reading the recommendations of Captain Desborough very carefully, but in glancing over them hurriedly, I do not see anything in reference to the inspection of fuses. Is it your idea not to have these inspected?

Captain Desborough.—I had thought of that, but I may say in this paper I have only touched on very general principles. I thought whether it was advisable to have a test for fuse was a matter which could be considered when the Act has passed through Parliament. The South African government has a very elaborate system of testing safety fuse, and they tell me it has been of very great benefit to them. In England we have no test of fuses, and I do not know whether the fact of not having a test has led to any increase of accidents. If there is a demand for a test, it would be a very good thing to have it.

Mr. Corkill.—My experience inspecting mines the last five years leads me to believe that there should be an inspection of fuse, and that fuses should be regulated so that the burning speed should be within certain limits. There are at the present time many makes of fuse sold in Ontario, and they are not of the same burning speed. Of course there is not a great deal of difference, but sometimes there is a difference which might lead to accidents. Another case is where we have a so-called quick fuse. Of course I do not think that is responsible for a great many of the accidents that occur. In fact, in a number of accidents I have investigated from the so-called quick fuse I have always found something else, but the miners all call it quick fuse if they happen to be caught. Still I have affidavits from fairly reliable miners that their fuse did in some cases burn faster than was safe. I have never yet in my own experience seen it, but still there is a possibility of it.

Captain Desborough.—You can reproduce it experimentally very simply with a pair of pliers.

Mr. Corkill.—I think in drafting the Bill there should be some regulations for the inspection of fuse. I have read with much interest the South African Act with regard to that, and I was very much impressed with it.

Captain Desborough.—The real difficulty, even in South Africa, is that fuse changes so much after storage. If you have a hard and fast rate of burning you may condemn fuse because it has got a little bit slower and just outside your limits.

Mr. CORKILL.—It is a very hard thing to regulate the storage of fuse. Most people when they get a box of fuse in a store put it near a stove, and soon it will be unfit for use.

Captain DESBOROUGH.—Personally I should prefer electric firing if I wanted to be very accurate about the time of burning.

Mr. CORKILL.—That brings up another thing. During the last six months we have had some electric time fuse that should be tested thoroughly by the new department before it is allowed to be sold, the same as any new explosive, and regulations framed accordingly; because no one knew anything about this new fuse. The miners had to experiment, themselves, with it. I do not know if we have had any fatal accident from it, but there is the possibility.

Captain DESBOROUGH.—My view of the new department is this, really, that explosives will be examined by the chemist solely with two objects in view, one to eliminate explosives which are unduly sensitive to friction and percussion, and the other to ensure that the explosives possess a reasonable degree of chemical stability. As regards the regularity, it would be a very difficult thing indeed to frame regulation to ensure it, and I think all one can do, anyway for the present, is to have a testing department of the new bureau opened to carry out experiments for the users of explosives. If a user wants to try a new explosive, I think it ought to be open to him to send it to the testing station, and let the authorities there give him such information as they can about its explosive qualities, such as speed of explosion possible, of kinetic energy, and other kindred matters, but I am rather averse to regulating what I may call the physical qualities of explosives.

Mr. CORKILL.—What about the gas? Is not that a point you are very strict about?

Captain DESBOROUGH.—It is a very difficult question to take up. We have discussed it a great deal in England, but except so far as coal mine explosives are concerned, we do not attempt to regulate it. Practically all explosives give off deleterious gases. Some are very much worse than others, depending on the completeness of their detonation. If the detonation is not complete, you get worse gases. Other explosives will give other gases if you light them. It is a question of degree. It is very difficult to regulate explosives so far as their fumes go. If you say they shall not give more than a certain percentage of carbon monoxide, a manufacturer will say, and reinforce it with experiments; under the conditions he carries on the experiment, the explosives are right. Then you have to blame the detonator. The maker of the detonator will say the detonator is all right, and the explosive all wrong.

Mr. CORKILL.—Should you not say that the amount of carbon monoxide should not exceed a certain quantity. We have had considerable trouble with gases, and a number of men have been asphyxiated.

Captain DESBOROUGH.—We have fired explosives from cannon, one case tamped, another case not tamped. You get absolutely different substances from the combustion. It leaves a loop hole open in this way, that the manufacturer of the explosives will quite rightly say this hole was not properly tamped, therefore you did not get the necessary confinement and did not get the final products of the explosion. It is impossible to prove it one way or the other, and you simply set people at loggerheads without any advantage.

Mr. CORKILL.—In the case of new explosives, there should be some regulation with regard to deleterious gases, carbon monoxide in particular.

Captain DESBOROUGH.—All you can do is to try to ensure that the quality of the explosives will be good. The whole question of detonation is such a very involved one that it is very difficult to frame any regulations which would meet your point.

Mr. CORKILL.—I see also here, with reference to detonators, you state it is very difficult to have a system of inspection.

Captain DESBOROUGH.—Not so much a system of inspection as formulating a test by which you compare different patent detonators.

Mr. CORKILL.—I think the regulations should be that weak detonators should be prohibited from sale altogether.

Captain DESBOROUGH.—I think the manufacturers here have agreed that there is no objection to specifying the minimum amount of explosives which must be present in a detonator of a particular number; that is, that a No. 6 detonator means that it contains one gramme of fulminate composition.

Mr. CORKILL.—I think the only way you can keep most of the miners from using inferior detonators is not to let them be manufactured.

Captain DESBOROUGH.—The other difficulty is this, it is very hard to persuade the user of explosives that it is false economy to use a cheap detonator.

Mr. CORKILL.—I have been trying to do that for five years and have not succeeded.

Mr. LESUEUR.—The No. 3 is the standard detonator in Canada, and in a country as cold as Canada I think it is not right.

Mr. CORKILL.—I must disagree with you. In mines they generally use a No. 6.

Mr. LESUEUR.—For construction work the No. 3 seems to be almost exclusively used, except for electric exploders, where they sometimes get double strength, which means No. 6.

Mr. MCMASTER.—I regret exceedingly that I am not, on account of want of knowledge, able to speak of the practical working of powder factories, or the technical parts. While I am sure we all are in sympathy with the desire to protect life and property, there is, of course, the commercial side of the question which has to be considered. Mr. McPherson raised an important point. He suggested that in any neutral market which the Canadian manufacturer might reach, it would be naturally a disadvantage to subject the producer in this country to onerous conditions in competition with manufacturers to the south of us. That is something we must ask the Government to take into consideration, because there is no question the climatic conditions here are somewhat different to those in Captain Desborough's country, and I have no doubt that has been taken into consideration by the Captain. In regard to the Orders-in-Council, if I understand the Captain correctly, he does not want to make hard and fast rules. I have had experience of Orders-in-Council in the past where interests have been affected. If the parties interested could have knowledge of what was intended to be enforced before the Orders-in-Council go into effect, it would be better.

Captain DESBOROUGH.—I go further than that; I say I think it should be absolutely necessary, but you must not take what I say as binding the Government.

Mr. McMaster.—I understand that. I should like very much if I were in a business which would be affected by Orders-in-Council, to be treated in that way. When you were speaking about the size of magazines on the other side of the Atlantic, there came to my mind the question of climatic conditions which do not exist here—that is, where large quantities have to be put into magazines at certain seasons of the year, and storage quantities must necessarily be larger.

Captain Desborough.—There is another reason for establishing small magazines; otherwise you could not maintain the distance from dwelling houses. We have a few magazines, of 200 tons capacity, but they are invariably old hulks moored in the Thames, or the Mersey, or other similar places, and it is because they cannot comply with the table of distances that they use these old hulks. They find them a great advantage now that they have adopted them.

Mr. McMaster.—I may say we shall be very glad to co-operate in making the tests suggested.

Mr. Riley.—I notice in the title of the Act there is no reference to regulating the use of explosives in any way. I presume it is intended to adopt Mr. Gibson's suggestion the other day, that this Act will only govern explosives in the hands of manufacturers, and once they become a usable commodity the provincial or municipal regulations will govern. There must be places where there are no such regulations, and I think with Mr. Corkill that the users—that is Mike and Tony at the end of the dump—must be protected from themselves to a certain extent regarding the quality of explosives and the caps and the detonators. If you could put in this Act certain general regulations applying to the transportation of explosives by wagon, and the use of explosives, these regulations to be framed by Captain Desborough, and other trained people, it would be a very great guide for local aldermen and others who know nothing at all of the conditions, and yet have to frame municipal regulations that they feel called upon to make. If you had some such general regulations for transport and use in the Act, or in the Order-in-Council in some way it would be a good model for the local people to adopt, and would tend to make the legislation on this matter uniform from one end of the country to the other.

Captain Desborough.—So far as transportation is concerned, I propose, if it is legal, that power should be taken to regulate the general transportation throughout the country. As far as the use is concerned I have recommended, again if it is legal, that the use of explosives in places which are not already governed by the Provincial Mines and Quarries Act should be governed by general regulations framed by the new department, but, of course, the question of legality is one which is difficult to settle, and has not been threshed out yet.

Mr. Riley.—I should like to emphasize that point, and also that I do not believe in trying to accomplish everything by legislation—that a certain amount of education should be undertaken by the Mines Department, such as other departments of the Government undertake. Another point I should like to have borne in mind—I notice the proposition is to adopt the American Bureau's regulations—to try and get from the railways better terms for the transportation of explosives than we can at present, because we have to pay for 5,000 pounds whether we ship that amount or less. I know as a matter of fact that this causes the smuggling of explosives on passenger trains to a certain extent. People carry them on the trains

when they should not. If we could ship, as they do in the United States, a box of explosives at a time it would be a good thing. It is a question which I should like you to bear in mind. I should like Captain Desborough to tell us also, from his experience in England, what protection the manufacturers have from the encroachment of dwellings around their factories. Does the proposed legislation mean that we have to bank up the whole of our factory with a mound to keep people from coming in on us, or that we must go a certain distance away from the border of our property before we put up any buildings?

Captain DESBOROUGH.—In practice in England the bulk of the factories have no fence around them, but they put up a notice to trespassers, and that notice is statutory. If a man is found trespassing on the property he can be apprehended and prosecuted.

Mr. RILEY.—I did not mean that so much. Suppose we have a building located in accordance with the table of distances, and some one comes and puts up a building close to us, have we to go so much farther back?

Captain DESBOROUGH.—Yes, you would, but in England it is always arranged by mutual agreement between the occupier of the land and the occupier of the factory.

Mr. RILEY.—The intra-table of distances is a very important matter with us, even in small works like ours. The winter before last we had a man with a horse and snow plough, and two shovellers at work all winter. This contributes to our cost above the cost of production in more southern climates, and if we have the additional distance to shovel the snow, the cost will be increased proportionately.

Captain DESBOROUGH.—I do not think you will find practically that it will make any difference. In your factory I believe there are greater distances than we require.

Mr. RILEY.—That is the cause of a good deal of the trouble. I should like to ask the Captain what is the ideal factory construction that we should work towards.

Captain DESBOROUGH.—I do not wish to accede to your request, because I do not know your Canadian winter, and what is suitable to us is not necessarily suitable to you. Throughout, my feeling has been not to lay down things hard and fast—to try and have as much elasticity as you possibly can. Of course there is the general principle that the working buildings should be of light construction, and that in a magazine the greater danger comes from without, and therefore, you must make the magazine more or less solid.

Mr. KENT.—According to Major Riley's intra-factory distance reference, it was said last week, by some one, that perhaps you will allow us five years, or recommend to the Government that the period allowed to factories existing to-day, under certain conditions, to conform to the new regulations covering distance, should be five years.

Captain DESBOROUGH.—I have noted that, but you must understand I cannot possibly bind the Government to any course. All I can tell them is what the feeling of the explosives trade is.

Mr. KENT.—You would not care to commit yourself to saying what your probable recommendation would be touching that point?

Captain DESBOROUGH.—I have had a conversation with Mr. Templeman on the subject, but I really am not at liberty to tell you what he said to me. I told him that in England we treated the existing factories too leniently.

Mr. KENT.—Yes, and you cited an instance.

Captain DESBOROUGH.—And as a compromise you should be given a certain time limit. What his views are on the matter I really cannot tell you.

Mr. KENT.—Is it anticipated that the legislation which will result from your recommendations will influence in any way, or modify, or affect the existing railway transportation regulations?

Captain DESBOROUGH.—What I have suggested is that the control of transportation by rail should be solely in the hands of the railway commissioners—in fact no one has power to take it out of their hands. I have no doubt they will co-operate with the new department, and in that, of course, the main difference between what exists at the present time and what will exist in the future, will be that the control of the type of explosive which is conveyed will rest in the hands of the Dominion Government instead of the private bureau in New York.

Mr. KENT.—That may or may not add to the transportation restrictions as they are at present.

Captain DESBOROUGH.—I can only repeat that I think, for the present, the regulations will remain absolutely as they are.

Mr. KENT.—I should like to ask Mr. Blood if it has been actually demonstrated, frequently, or unfrequently, where shipping detonators by wagon, by rail, by boat, or otherwise, with dynamite or other explosives, is practised, when those detonators have been properly, carefully, and intelligently packed—if it has been demonstrated that the danger is increased to any extent?

Captain DESBOROUGH.—I should think it is a matter of common sense that if you put detonators close to your dynamite you must have greater danger of explosion.

Mr. BLOOD.—I should like to put it in this way: a short time ago in the Province of Quebec, there were two teams unloading a carload of 600 cases of dynamite. The teams were on their way to the magazine. The first team in turning a corner very nearly collided with a sleigh in which a party was out riding. The second driver was negligent and did not notice that the first team had stopped until the pole of his wagon struck the front wagon, perforated it, and passed through four or five boxes of cartridges and scattered some of them on the street. It might just as well have been a box of detonators and caused an explosion. I understand not long ago a horse ran away in the city of Ottawa and scattered dynamite along five or six blocks, and shortly afterwards a child picked up a detonator and pricked it with a pin, and it exploded in his hands. I have heard that, I do not know if it is true.

Mr. KENT.—I admit that it is a matter of common sense that if there are detonators with other explosives the danger is increased to a certain extent; but it is equally a matter of common sense that if there are two cases of dynamite, or three cases, the danger is increased by the difference in the quantity of explosives in any given place or at any given point. What I asked you to tell me was if it had been

demonstrated, to your knowledge; or can you cite any instance from your own experience of accidents, or serious explosions, resulting from the detonation of caps carefully packed and transported with dynamite?

Captain DESBOROUGH.—I cannot tell you, because in England it is absolutely prohibited.

Mr. KENT.—Infractions of that regulation are not heard of?

Captain DESBOROUGH.—No, it is absolutely prohibited, and I do not think any manufacturer would want to do it.

Mr. BLOOD.—It is prohibited in the United States and Canada. I have known violations through ignorance, but I do not know of accidents which could be directly traced to the violation.

Mr. MCPHERSON.—I have here before me the form of license submitted to us to-day. I understand from the various paragraphs here that you must first obtain permission to apply for a license.

Captain DESBOROUGH.—I did not really mean the first two or three pages to refer to you. I was just showing you the terms of the license. Of course, to an actual license a plan would be attached.

Mr. MCPHERSON.—I see provision made in the license for the testing of clothing of workmen employed. That such clothing shall be of non-inflammable material. That would mean only clothing of that character should be used—there is no uniform clothing required?

Captain DESBOROUGH.—We have a small apparatus for testing clothing. What we want to eliminate is thin cotton, particularly in black powder factories. Our experience has been in explosive factories where the main danger is from fire as opposed to explosion, it is very important that the workmen should wear relatively non-inflammable clothing.

Mr. DRACKETT.—I have seen an abstract of a report from German experiments on fireproof clothing. The abstract shows that the experiments developed that fireproof clothing is of no use.

Captain DESBOROUGH.—I do not know what the German fireproof clothing is, but I know we have had a considerable number of lives saved by its use in England. It is absolutely beyond question.

Mr. DRACKETT.—That is in connexion with black powder?

Captain DESBOROUGH.—I do not refer to any particular cloth. Most of our people wear closely woven woollen clothing. What you want is when the actual source of fire is removed the material will not go on burning. Our system of testing is to place the cloth on a frame about a foot square and standing about six inches above the table. Then underneath the centre, in a pan, we use cordite and ignite a definite quantity of it, which burns for a definite time, and makes a big flame. If the flame does not pass through the clothing, and the clothing does not carry fire after the explosive is burned out, we consider the clothing sufficiently satisfactory.

Mr. DRACKETT.—How long a flame is that as to time—very short?

Captain DESBOROUGH.—I should think somewhere about a minute.

Mr. DRACKETT.—I have tried clothing for black powder. It does not seem to stand up that way.

Captain DESBOROUGH.—If you come to England I can show you plenty of samples which stood the test very well.

Mr. DRACKETT.—You spoke of floating magazines; are the distances different for floating magazines?

Captain DESBOROUGH.—We consider, as far as floating magazines are concerned, so long as the explosive is kept below the water line, that counts as very adequate mounding, and you get favourable distances. As a rule, from the configuration of the bank of the river, or whatever it may be, you may consider you have natural features of the ground intervening, and, therefore, the distances are probably reduced by three-quarters.

Mr. DRACKETT.—I suppose it depends on the judgment of the inspector.

Captain DESBOROUGH.—Yes, it is left to the judgment of the inspector. What struck me was they might be of great use here on the west coast of Canada. I was not thinking of the east coast at all.

The CHAIRMAN.—Before adjournment I want to make the remark that the proceedings of this meeting will be published, and copies sent as early as possible, as was done in connexion with the first meeting.

Mr. MCMASTER.—I wish to express the thanks of the meeting to Captain Desborough for his kindness in allowing the gentlemen here to express their views on the subject of the proposed legislation. I am sure all of us agree that we are very much obliged to him for the opportunity. (Applause).

The CHAIRMAN.—I am inclined to think that all the difficulties in carrying out the Bill will be matters of administration. The Bill itself will be an exceedingly short one. Therefore, it will require at the head of the division of the Mines Branch a man of great ability, judgment, and practical knowledge. Since the new regulations will be made by Order-in-Council I think that in the matter of these regulations plenty of opportunity should be given to manufacturers, and all concerned, to express their views. I myself would be strongly in favour of having nothing done without advice and consultation with the parties who are concerned.

Mr. MCMASTER moved that a vote of thanks be extended to Dr. Eugene Haanel, Director of Mines, and to Captain A. P. H. Desborough, Inspector of Explosives, from the Home Office, London, England, for their consideration in calling this Conference, and for the explanation of their recommendation, which Captain Desborough proposes to make in his report to the Minister of Mines. The motion was carried with acclamation, and the proceedings terminated.

SESSIONAL PAPER No. 26a

APPENDIX III

(Copy)

3rd Session, 11th Parliament, 1 George V, 1910-11.

THE HOUSE OF COMMONS OF CANADA.

BILL 79.

An Act to regulate the manufacture, testing, storage and importation of Explosives.

HIS Majesty, by and with the advice and consent of the Senate and House of Commons of Canada, enacts as follows:—

SHORT TITLE.

1. This Act may be cited as *The Explosives Act.* Short title.

INTERPRETATION.

2. In this Act, unless the context otherwise requires,— Definitions.

(*a*) "Department" means the Department of Mines; "Department."

(*b*) "Minister' means the Minister of Mines; "Minister."

(*c*) "authorized explosive" means any explosive the manufacture of which has been authorized under this Act; "Authorized explosive."

(*d*) "explosive" means and includes gunpowder, blasting powder, nitro-glycerine, gun cotton, dynamite, blasting gelatine, gelignite, fulminates of mercury or of silver, fog and other signals, fireworks, fuses, rockets, percussion caps, detonators, cartridges, ammunition of all descriptions, and every other substance, whether chemical compound or mechanical mixture, which has physical properties similar to those of the substances above mentioned, and every adaptation or preparation of everything above named; "Explosive."

(*e*) "factory" means and includes any building, structure, or premises in which the manufacture or any part of the process of manufacture of an explosive is carried on, and any bu lding or place where any ingredient of an explosive is stored during the process of manufacture; "Factory."

(*f*) "inspector" means and includes the chief inspector of explosives, an inspector of explosives, a deputy inspector of explosives, and any other person who is directed by the Minister to inspect an explosive or explosive factory or magazine, or to hold an inquiry in connexion with any accident caused by an explosive; "Inspector."

"Magazine." (*g*) "magazine" means and includes any building, storehouse, structure, or place in which any explosive is kept or stored; other than at or in and for the use of a mine or quarry in a Province in which provision is made by the law of such Province for the efficient inspection of mines and quarries;

"Occupier." (*h*) "occupier" means any person who operates a factory for manufacturing explosives, or is the manager of or in charge of such factory, or who is the occupant of or uses a magazine for the storage of explosives;

"Regulations." (*i*) "regulations" means any regulations made by the Governor in Council under the authority of this Act;

"Safety cartridges." (*j*) "safety cartridges" means cartridges for guns, rifles, pistols, revolvers, and other small arms, of which the case can be extracted from the small arm after firing, and which are so closed as to prevent any explosion in one cartridge being communicated to other cartridges.

Departments exempted. **3.** This Act does not apply to the Department of Militia and Defence or the Department of Naval Service.

IMPORTATION, MANUFACTURE, AND USE.

Explosives prohibited unless authorized. **4.** Except as herein provided, no person shall have in his possession, or import, store, use, or manufacture, whether wholly or in part, or sell, any explosive unless such explosive has been declared by the Minister to be an authorized explosive.

Small quantities excepted. **5.** Nothing in this Act shall apply to the making of a small quantity of explosive for the purpose of chemical experiment, and not for practical use or sale.

Certain process prohibited. **6.** Except in so far as may be permitted by regulations made under this Act, no person except in licensed, manufacturing factories, shall carry on any of the following processes, namely: of dividing into its component parts, or otherwise breaking up or unmaking, any explosive; of making fit for use any damaged explosive; or of remaking, altering, or repairing any explosives; provided that this section shall not apply to the process of thawing explosives containing nitro-glycerine, if a proper apparatus or thawing-house is used.

LICENSES AND PERMITS.

Licenses. **7.** The Minister may issue licenses for factories and magazines, and no one shall manufacture, either wholly or in part, or store explosives except in licensed factories and magazines.

Permits for importation. **8.** The Minister may issue permits for the importation of authorized explosives, and no one shall import any explosive into Canada without such permit; provided, however, that nothing in this section shall prevent any explosive from being transported through Canada by railway in bond, if such transportation is made in a manner authorized by *The Railway Act* or any regulation or order made thereunder.

Transport in bond.

Special permits

9. The Minister may, on application, and on payment of the prescribed fees, issue a special permit to import, for the purpose of chemical analysis or scientific research, an amount not exceeding two pounds of any explosive specified in such permit.

Application for license.

10. Applications for factory or magazine licenses shall be made in such form and manner as are prescribed by regulation, and the application shall be accompanied by,—

Plan of factory and premises.

(*a*) a plan, drawn to scale, of the proposed factory or magazine, and of the land on which such factory or magazine is situated, and also of the lands adjacent thereto on which buildings are erected, with the uses to which such lands and buildings are now put. Such plan to have the exact distances between the several buildings marked thereon;

Description.

(*b*) a description of the situation, character, and construction of all buildings and works connected with the factory or magazine, and the maximum amount of explosive to be kept in each building;

Statement of employes.

(*c*) a statement of the maximum number of persons to be employed in each building in the factory or magazine;

Required information.

(*d*) any information or evidence which the Minister may require;

Statement of maximum amount and ingredients

(*e*) in the case of an application for a factory license, a statement of the maximum amount of explosive, and of ingredients thereof wholly or partially mixed, to be allowed at any one time in any building, machine, or process of the manufacture, or within the distance from such buildings or machine which is limited by regulation;

Statement of processes and position of explosives.

(*f*) a statement of the nature of the processes to be carried on in the factory and in each part thereof, and the place at which each process of the manufacture, and each description of work connected with the factory is to be carried on, and the places in the factory at which explosives and anything liable to spontaneous ignition, or inflammable or otherwise dangerous, are to be kept.

Consent of municipality and Minister before license granted.

11. No license shall be granted for any factory or magazine hereafter established within the limits of, or within one mile of the limits of, any city, town or incorporated village, or elsewhere except with the approval of the municipal corporation or other local authority having jurisdiction, or the Government of the Province, if in a Province, and in territory where there is no local authority having jurisdiction, and also with the consent of the Minister.

Permits for experiments, and testing new explosives.

12. The Minister may, on application and on payment of such fees as are prescribed by regulation, issue a permit to manufacture for experimental purposes or for testing and special blasting operations only, and not for sale, any new explosive, upon such conditions and subject to such restrictions as are fixed by the Minister.

Permit for alteration or addition to factory.

13. The owner or occupier of a factory or magazine shall not make any material alteration or addition to a licensed factory or magazine, or rebuild any part thereof, until he has obtained a permit from the Minister; and before such permit may be granted he shall submit such plans and other information and evidence as the Minister may require.

Change of owner or occupier.

Notice to Minister.

Penalty

14. A factory or magazine license shall not be affected by any change in the person of the owner or occupier of the factory or magazine; but notice thereof, with the address and calling of the new owner or occupier, shall be sent by the owner to the Minister within three months after such change, and in default thereof, the new owner and occupier shall each be liable to a penalty not exceeding one hundred dollars for every week during which such default continues.

License for factory now in operation.

Proviso.

15. In the case of a factory now in operation or a magazine now in existence, no license shall be required until the first day of January, one thousand nine hundred and sixteen; provided, however, that if the owner or occupier of such factory or magazine desires to make any material alteration in or addition to such factory or magazine, or to rebuild the same or any part thereof, he shall comply with the provisions of section 13 of this Act.

Application for continuing certificate.

Particulars.

2. The owner or occupier of any such factory or magazine shall, within three months after the passing of this Act, make application to the Minister for a continuing certificate, stating in such application his name and address and the situation of the factory or magazine, and shall supply such particulars and information respecting the same as the Minister may require; and the applicant shall, thereupon, be granted a continuing certificate in such form as may be prescribed by the Minister, and such factory or magazine shall thereupon be deemed to be duly authorized to manufacture and store explosives.

Powers of Minister in case of special danger.

3. Notwithstanding anything in this section, the Minister may require the owner or occupier of any factory or magazine to stop using, or to use only under and subject to conditions to be specified by him, any building, structure, or premises which, from its situation or from the nature of the processes carried on therein, constitutes, in his opinion, a special danger.

INSPECTORS.

Appointment of inspectors.

16. The Governor in Council may appoint a chief inspector of explosives, one or more inspectors of explosives, one or more deputy inspectors of explosives, and a chemist of explosives.

Powers of inspectors.

17. An inspector may, at any time, visit and inspect any factory, magazine, and premises where any explosive is being manufactured or stored, or where he has reason to suspect any explosive is being manufactured or stored, and to open and examine any package that he may there find; and the owner and occupier of such factory, magazine, and premises, shall afford such inspector every facility to make such inspection full and complete, and shall supply the inspector with any information that he may require, other than information relating to the cost of manufacturing any explosive.

May require samples.

2. An inspector may require the owner or occupier of any factory, or magazine, where any explosive is manufactured or stored, or any person employed in any such place, to give him such samples as he may require of any substance therein, whether in the state of raw material, material in course of manufacture, or manufactured material, which the inspector believes to be an explosive, or to be an ingredient from which an explosive may be manufactured.

3. An inspector may, at any time, open or cause to be opened any package or store of material of whatsoever nature, which he believes to contain explosives or ingredients for the manufacture of explosives. May open packages.

INQUIRIES INTO EXPLOSIONS.

18. The Minister may direct an inquiry to be made whenever any accidental explosion of an explosive has occured, or when any accident has been caused by an explosive, and the person authorized by the Minister to conduct such inquiry shall have all the powers and authority of a commissioner appointed under Part I of *The Inquiries Act*. Inquiry into accidents.

2. This section shall not apply, however, where an accident has been caused by an explosion of an explosive occuring in any mine or quarry, or metallurgical work in any Province in which provision is made by the law of such Province for a proper and thorough investigation and inquiry into the cause of such accident. Exemption: where covered by Provincial legislation.

REGULATIONS.

19. The Governor in Council may make regulations— Regulations.

(*a*) for classifying explosives, and for prescribing the composition, quality, and character of explosives; Classify explosives.

(*b*) prescribing the form and duration of licenses, permits, and certificates issued under this Act, the terms and conditions upon which such licenses, permits, and certificates shall be issued, and the fees to be paid therefor; Licenses, permits, and certificates.

(*c*) for regulating the importation, packing, and handling of explosives, and the transportation of explosives otherwise than by railway; Importation, packing, and transportation.

(*d*) for inquiries into the accidental explosion of explosives, and any accident caused by explosives; Inquiries into accidents.

(*e*) for the taking of samples of explosives required for examination and testing, and for the establishing of testing stations, and of the tests and other examinations to which explosives shall be subjected; Samples. Testing.

(*f*) prescribing the manner in which an explosive shall be tested and examined before it is declared to be an authorized explosive, and for determining to what examinations and tests authorized explosives shall be subject; Authorized explosives.

(*g*) to be observed by inspectors and other officers and employes charged with any duty under this Act, or under any regulations made thereunder; Inspectors and officers.

(*h*) relating to the construction and management of factories and magazines; Factories.

(*i*) for the safety of the public and of the employes at any factory or magazine, or any person engaged in the handling, or packing of explosives, or the transportation of explosives otherwise than by railway; Safety of public and employes.

(*j*) governing the establishment, location, and maintenance of factories and magazines, and the manufacture and storage of explosives; Location and manufacture.

(*k*) for the more effective carrying out of this Act. Operation of Act.

2. All regulations made under this Act shall be published in *The Canada Gazette*, and upon being so published they shall have the same force as if they formed part of this Act. Publication.

OFFENCES AND PENALTIES.

Obstruction of entry and examination by inspector.

20. Every person who fails to permit an inspector to enter upon any property, and to inspect, examine, or make inquiries in pursuance of his duties, and every person who fails to comply with any order or direction of such inspector, in pursuance of the requirements of this Act, or any regulation made thereunder, or who, in any manner whatsoever, obstructs such inspector in the execution of his duties under this Act, shall be liable to a

Penalty.

penalty not exceeding five hundred dollars and costs.

Manufacturers objections to Inspectors ruling referable to Minister for adjudication.

2. Any manufacturer who takes exception to the ruling of an inspector, before such ruling or before the penalty provided for in subsection (1) one of this section is enforced, as the case may be, may have the facts upon which such ruling is based submitted to the Minister for his consideration and decision.

Trespassing upon premises.

21. Every person who enters without permission or lawful authority, or otherwise trespasses upon any factory or magazine, shall, for every offence, be liable to a penalty not exceeding fifty dollars and costs, and may be forthwith removed from such

Penalty.

factory or magazine by any constable, or by any person employed at such factory or magazine.

Causing explosion or fire.

22. Every person who commits any act which is likely to cause an explosion or fire in or about any factory or magazine, shall be

Penalty.

liable to a penalty not exceeding five hundred dollars and costs.

Possession, sale, manufacture, or importation of unauthorized explosive.

23. Every person who, by himself or his agent, has in his possession, sells, offers for sale or manufactures or imports any unauthorized explosive within the meaning of this Act shall, for a first offence, be liable to a penalty not exceeding two hundred dollars and costs, or to imprisonment for a term not exceeding three months, or to both penalty and imprisonment, and for each subsequent offence shall be liable to a penalty not exceeding five

Penalty.

hundred dollars and costs, and not less than fifty dollars and costs, or to imprisonment for a term not exceeding six months, or to both penalty and imprisonment.

Contravention of Act.

24. Every person who violates any provision of this Act for which a penalty has not been provided, or any regulation made thereunder, shall, for a first offence, incur a penalty not exceeding

Penalty.

two hundred dollars and costs, and for each subsequent offence a penalty not exceeding five hundred dollars and costs.

Recovery of penalties.

25. Every penalty and forfeiture may be recovered in a summary manner under the provisions of Part XV of *The Criminal Code*.

COMMENCEMENT OF ACT.

Commencement of Act.

26. This Act shall come into force on a day to be fixed by proclamation of the Governor in Council.

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DEPARTMENT OF MINES

MINES BRANCH

HON. W. TEMPLEMAN, MINISTER

EUGENE HAANEL, DIRECTOR

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No. 91

MAP SHOWING
COBALT, GOWGANDA, SHININGTREE,
AND PORCUPINE DISTRICTS

CANADA

DEPARTMENT OF MINES

MINES BRANCH

HON. W. TEMPLEMAN, MINISTER; A. P. LOW, LL.D., DEPUTY MINISTER;
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REPORTS, AND MAPS OF ECONOMIC INTEREST.

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